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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 161

Obituary Note, Mr. Milton J. Payne—Obituary Note, Mr. James J. McKeever—"Field's Analysis," for 1899—Notes.

Eighth Annual Meeting, Pacific Coast Gas Association.—Official Report. Revised by the Secretary 162

First Day, Morning Session—Roll Call—Election of New Members—Inaugural Address.

*Electrolysis of Underground Metallic Structures, by Mr. Dabney H. Maury 165

Alternating Current Generators, by Mr. H. G. Heist 170

Special English Correspondence 172

Concerning the Association, the Institute, the Institution, the Society and the False Prophets.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 173

Something from Bridgeton, N. J.—The Rew Memorial Library—Annual Meeting, Nashville, Tenn.—Tar Contract, Richmond, Va.—Executive Management, Manchester, (N. H.) Company—The Messrs. Danforth Secure Control at Pekin, Ills.—Annual Meeting, Albany, N. Y.—The Long Beach (Cal.) Company—Executive Management, Consol. Gas Company, Baltimore, Md.—The Gas Franchise for Steelton, Pa., Refused—Annual Meeting, Rutland, Vt.—Cost of Power in Bulk—The Public Electric Lighting of Wilmington, Del.—And Other Items.

The Market for Gas Securities 175

BRIEFLY TOLD.

OBITUARY NOTE, MR. MILTON J. PAYNE.—It is with sincere regret that we have to report the death of Mr. Milton J. Payne, President of the Kansas City Missouri Gas Company, whose demise occurred, at his home in Kansas City, Mo., the morning of July 17th. Although in his 71st year, and having suffered quite severely from illness for several months, those nearest him were not seriously alarmed over his condition, until perhaps a fortnight or so before the end came, for his wiry personality had often brought him safely through attacks which bordered on the serious. This time, however, death would not be denied. Milton J. Payne was born in Hopkinsville county, Kentucky, October 29, 1829. When quite a young lad he took service with a Hopkinsville printer, and for two years struggled with the case and press. Finding the printing business not to his liking, he essayed clerking it in a Hopkinsville dry goods shop. In 1849 he became imbued with the restless desire to search for gold on the Pacific Coast that then affected so many, and actually started on the long journey. Reaching St. Louis he met a friend who counselled with him over the recklessness of the chance he was taking, and the result of the counselling was that he accepted a place in the counting room of a St. Louis dry goods house. Late in 1850 he removed to Kansas City, there to assume a responsible position with the firm of Walker, Boyd & Chick, at that time the largest mercantile house in Kansas City. From that date his promotion and advancement were in every sense of the speediest sort. In 1852 he married Miss Mary A. Prudhomme, daughter of Gabriel Prudhomme. The latter owned many acres of the old town of Kansas City, and when Kansas City proper was incorporated the subject of this sketch was recognized on all sides as the representative of his father-in-law. This recognition, which was accentuated by his own magnetic personality, soon made him a strong factor in politics, with the result that he was named as the fourth Mayor of Kansas City (June, 1855), which place he acceptably filled for six terms. It is recorded of him that to his skillful direction of its affairs in its growing days Kansas City owes much of its present strength—when he was first chosen its Mayor its population was less than 2,000. In 1862, and again in 1864, he was elected to the State Legislature. His business interests naturally grew in proportion to his interest in public affairs, and the examiner of his career will be confronted with positive evidence of his activity in many enterprises. In 1867, largely through his efforts, the Kansas City Gas Light and Coke Company was organized. He was its first President, and served it as such, until it was merged with the opposition concern, known as the Missouri Gas Company, under the title of the Kansas City, Missouri, Gas Company. He was chosen President of that corporation, and was its President at the time of his death, which is sufficient proof that the capitalists working with him for many years were believers in his business capacity and sterling faithfulness. He was elected to membership in the Western Gas Association, at its meeting held in St. Louis, May, 1884, and joined the American Gas Light Association at the meeting held in Cincinnati, October, 1885. The funeral services were held in his late home, 2800 Main street, Kansas City, the afternoon of July 19th, the Reverend J. M. Cromer officiating. Interment was made in the Union Cemetery, of which corporation he had been President for several years.

OBITUARY NOTE, MR. JAMES J. MCKEEVER.—The fraternity in general, and those of its Southwestern section in particular, will learn with regret of the death of Mr. James J. McKeever, who since 1892 was the General Manager of the Houston (Texas) Gas Light Company. Deceased was born in New York city, September 17, 1833, where his education was acquired. He early took service with the Adams Express Company, and his relations therewith obliged him to settle for a time in the named cities in the order given: Philadelphia, 1856; Memphis, Tenn, 1859, and New Orleans, La., 1859. In 1865 he settled in Galveston, Texas, where he organized the Texas Express Company, and shortly thereafter removed to Houston, to form the Phœnix Express Company. He next entered the service of the International and Great Northern Railroad Company, resigning his connection therewith to engage in the grain business. Other lines of trade were tried by him with varying success, until 1892, when, at the invitation of Mr. T. W. House, President of the Houston Gas Light Company, he assumed the duties of Manager of that corporation, which trust he successfully carried on to the end of his time. Mr. John H. Fitzgerald, Superintendent of the Houston Gas Light Company, to whom we are indebted for the main facts in the foregoing, in his inclosure says: "In sending you the inclosed account of Mr. McKeever's death and sketch of his life, I cannot refrain from adding my personal tribute to his memory. The eight years we have been associated together constituted an unbroken chain of friendship and good will. As Manager, he was kind, but firm, to all under his direction, and I am sure I voice the unanimous sentiment of the employees of the Houston Gas Light Company when I say we felt his death as a keen personal loss. He entered the gas business late in life, but brought into it the energy and enthusiasm of a new convert; and that energy and enthusiasm never flagged until his spirit left him."

"FIELD'S ANALYSIS" FOR 1899.—We are in receipt, through the courtesy of the compiler, Mr. John W. Field, of London, England, of a copy of his "Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland and Ireland for the year 1899." No lengthier criticism nor may a more favorable one be written of it than to say that it is in every respect up to its predecessors. Its tabulations are a credit to his skill as an accountant, and their teachings are proof beyond doubt that the gas business still flourishes amazingly in England, Scotland and Ireland. Those who desire copies of the last Field's may obtain them through an order sent to the publishers of the JOURNAL.

NOTES.—The Kentucky Heating Company, of Louisville, Ky., pending the result of its appeal from the decision of Judge Toney, prohibiting it from supplying gas on illuminating account, is removing the meters through which a lighting supply was furnished. It has also increased its gross rate for a heating supply to 55 cents per 1,000 cubic feet. The prior charge on the latter account was 35 cents per 1,000. Its charge for gas used for illuminating purposes was 70 cents per 1,000.——Mr. Thomas Dolan, President of the United Gas Improvement Company, denies positively that he proposes to retire from that post. The Philadelphia newspapers had it last week that such was his purpose in the near future.——The Laclede Gas Light Company, of St. Louis, has entered formal complaint with the Board of Public Improvements and the City Lighting Department that its mains are being damaged by electrolytic action, due to the carelessness of the local electric street railways.——At a special meeting of the Directors of the Kansas City, Missouri, Gas Company, convened for the purpose of adopting a suitable minute to the memory of Mr. Milton J. Payne, President of the Company, the following resolutions were adopted:

"In the death of our esteemed and beloved friend and associate, Milton J. Payne, the President of this Company, which occurred on the morning of Tuesday last, we recognize that this Company, and all of its officers and employees, have sustained a great and irreparable loss.

"For over 30 years, nearly a third of a century, he has guided the destiny of this Company and its predecessors, as chief executive. He presided at its birth, when Kansas City was but a struggling village, and from that time to the present, in all the vicissitudes of fortune through which this Company has passed, his tireless, unselfish and faithful devotion to the Company's interests challenges our greatest admiration. He has indeed been its pillar of cloud by day, and in the darkest nights of its history, its pillar of fire.

"We shall sorely miss his wise counsel and direction, his kindly and genial presence, his courtly and refined manners.

"We extend to his family, in this hour of their great bereavement, our deepest sympathy, and order that these resolutions be spread upon the records of this Company, there to remain a memorial to his memory."

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.]

EIGHTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

HELD IN SAN FRANCISCO, CAL., JULY 10, 11 AND 12, 1900.

FIRST DAY—MORNING SESSION.

The eighth annual meeting of the Pacific Coast Gas Association was convened in the offices of the San Francisco Gas and Electric Company, at 11 A M. of the 10th inst., by the President, Mr. John Clements, of Red Bluff, Cal. The Secretary, Mr. J. B. Grimwood, of San Francisco, occupied the recorder's desk.

On motion of Mr. Aldrich, the reading of the minutes of the last annual meeting was dispensed with.

ROLL CALL.

The calling of the roll was responded to by the following:

Adams, H. E.	Eichbaum, C. W.	Kaneen, J. S.
Adams, C. F.	Froelich, C.	Kullman, J.
Aldrich, W. A.	Fogg, L. F.	Keaton, G.
Burrows, C. E.	Foveaux, F.	Kinney, G. I.
Britton, J. A.	Grant, E. P.	Lowe, L. P.
Barrett, W. G.	Goodman, H. P.	Miller, C. O. G.
Boardman, W. F.	Gregory, O. M.	McNeil, J.
Beck, A. C.	Guthrie, S.	Osborne, M. C.
Crockett, J. B.	Gillespie, W. W.	Parker, T. R.
Converse, C. M.	Grimwood, J. B.	Powers, R. M.
Clements, J.	Gutsch, A.	Rice, A. L.
Cushing, S. B.	Howard, J. L.	Thomas, J. W.
Callender, E. P.	Holberton, G. C.	Thompson, G.
Collins, D. J.	Hollidge, G. H.	Taylor, G. H.
Colquhoun, G. S.	Hitzeroth, L. D.	Thompson, T.
Cheffiens, E. F.	Hunt, C. M.	Vanderwhite, A. J.
Eichbaum, F. H.	Jones, E. C.	Wilson, G. W.
Ewing, E. E.	Joslyn, H. R.	

ELECTION OF NEW MEMBERS.

On motion of Mr. Crockett, the names of the following applicants for membership, whose eligibility had been certified to by the Board of Directors, were placed on the rolls—Secretary Grimwood having been instructed to cast the ballot in favor of their election:

Baker, M., San Francisco.	Jones, F. C., San Francisco.
Burkhart, H. W., Oakland.	Keyes, H. C., Sacramento.
Casey, W. J., San Francisco.	Lowe, S. C., Hollister.
Clarke, O. E., Napa.	Pedersen, B. S., Fort Wayne, Ind.
Clarke, R. L., San Diego.	Parker, J., Napa.
Fiest, A., San Francisco.	St. Clair, L. P., Jr., Bakersfield.
Funk, P., Santa Cruz.	Thompson, G. T., Denver, Col.
Fourness, W. A., San Francisco.	Thompson, Jr., Colusa.
Guenter, C. M., Phila., Pa.	Vanderhurst, W., Salinas.
Hayne, D., San Francisco.	Valentine, R. P., Sacramento.
Hughes, C., Red Bluff.	

The election having been declared, the President, after calling Mr. Parker to the Chair, read the following

INAUGURAL ADDRESS.

Fellow Members of the Pacific Coast Gas Association: Another, and the eighth, annual session will soon be added to the life of our Association. To one and all I hope it has been a year of profit commensurate with the toils and duties attendant upon it. It is indeed a great pleasure to meet you here once more, to hear your kind words of welcome, and receive the grasp of your hands that show how earnest your hearts are for the success of the Association.

The year has wrought many changes among gas men on the Coast. Some who a year ago were actively engaged in the gas business are no longer at the desk, the office, or "*facing* the retorts of clay or of gas consumers."

The grim messenger has visited our ranks, and while in point of numbers he has dealt kindly towards us, yet we have to record the loss of one of our most staunch and sturdy pioneer citizens and fellow members.

On January 5th of this year the immortal soul of David E. Knight was called from its earthly tenement to the mysterious beyond. In the death of Mr. Knight the Pacific Coast Gas Association has lost one of its most earnest members, and the craft in general one of the pioneers indeed in the manufacture of gas on the Pacific Coast.

Speaking of this grand old man, I will quote a few lines from a letter, written by our fellow member, C. E. Burrows, of Walla Walla, Washington, to Past President T. R. Parker, and by him kindly sent to me. Mr. Burrows was a fellow passenger on the steamship with Mr. Knight, in the year 1852, en route for California via the Nicaragua route. Although they were strangers they soon became well acquainted, and, as Mr. Burrows says, the acquaintance formed at that time ripened

into a friendship that continued until Mr. Knight was called to a higher life.

Of him Mr. Burrows says: "Mr. Knight was industrious. He found employment in a short time after landing as an engineer of the Sacramento water works. Mr. Knight was frugal, for he soon had money enough saved to send for his wife. Mr. Knight's first business venture was a small brass finishing shop on Jones street, San Francisco. Mr. Burrows, in speaking of Mr. Knight, says his wife was truly a helpmate, for together they toiled, always making advancement. Later he sold his shop and joined with Mr. A. Pearce and Mr. Charles Simpkins, and they together built the gas works at Marysville, Cal. From that time to the day of his death a history of Marysville would be largely the life of D. E. Knight. In proof of this is the following from one of his late home papers:

"David E. Knight has long been a force of no uncertain quantity in the events which have followed down in the history of the city of Marysville. Possessed of a tenacious, rugged personality, he was a man strong in his friendships, and one who preserved to the last the undying fidelity of a large number of our best citizens, many of whom, especially among the older element, had been his social and business associates for the past 40 years. 'Dave,' as he was called by his intimates, was always a man that they could 'back up against,' no matter what the exigency of business or political contingencies, and rest firm in the knowledge that the wall would never give, might the storm be ever so severe or the outlook ever so dreary. No such word as 'fail' was ever known to David E. Knight. When he put his hand to the plow on a proposition it was a well-known fact that he was there to win or, failing temporarily, he would fight it out on that line till the crack of doom. He was of the stuff of which men are made, beloved by his friends and respected by his opponents.

"In comparison to the ordinary run of men, David E. Knight stood, as does the grand old oak beside the clinging woodbine, a tower of strength to those who leaned upon him, and the storms of winter nor the summer's heat ever operated to weaken his fidelity toward those who basked in the light of his esteem."

His funeral was largely attended, our own Association being represented by Past-Presidents Jones and Parker. Mr. Jones, in writing of our deceased friend and fellow member in the AMERICAN GAS LIGHT JOURNAL, has this to say of him: "Mr. Knight was a man of rugged personality and strong in his friendships. Scorning to pause for the enjoyment of that retirement to which his efforts had entitled him, and which his success had made possible, he labored on, each day's duties cheerfully met—each night's repose honestly earned."

Quoting again from one of the Marysville papers: "Mr. Knight was philanthropic; his wont was to turn his thoughts on the many in need of his aid. And this aid was administered in the most kind and delicate manner. He waited not to be solicited; he stopped not to be thanked. It is said of him that in his charities he allowed not his left hand to know what his right was doing. Simple in his manner and unostentatious in his habits, he was a man among men. Tennyson, *in memoriam:*

> "'A life in civic action warm,
> A pillar steadfast in the storm.
> So bring him to rest beneath the clover sod
> That takes the sunshine and the rain,
> Or where the kneeling hamlet drains
> The chalice of the grapes of God.'"

As a mark of our esteem for our late member I would recommend that a committee be appointed to draft suitable resolutions, and that the same be made part of the proceedings of this session.

When, at your last regular meeting, you chose me to fill this high office, I assure you it was with a sense of fear that I accepted it, and that fear was I might not be able to fulfill the duties that would devolve upon me. And that fear has been with me ever since. When I thought of the men who had preceded me! To fill the place of a Crockett, a Jones, a Quilty, a Parker, an Eichbaum, or an Adams, was no small matter; so I felt I was hardly equal to the task. Therefore, what I may have to offer you in this humble address must be taken by you with full sized grains of allowance.

Our Association has long since taken its place among the best and foremost of the Gas Associations of the world. Most of you are fully acquainted with its entire history, from the time that Crockett and Jones sent out what I choose to term the feeler to the gas men of the Pacific Coast, asking them to come together for the purpose of forming this Association. That it was formed and fully moulded needs no proof at my hands. Each and every one of you I am satisfied feels that it has been in every way a success, because you have been benefitted by and enjoyed its annual reunions.

Here you have heard words of wisdom and received instructions that were valuable. Here has been unfolded to you as an open book the research of men of science. Here you have been able to observe the results of the handiwork of the toilers in the active duties of the practical part of the management of the gas business, from the office, the laboratory, the workshop, the miles upon miles of street mains, and even unto the depths of the coal mines and the lower depths of the rich, overflowing oil wells. Here you have met face to face and exchanged your experiences with each other. You have had laid before you the handiwork of deft fingers at the draughtsman board, making all so plain that even he who runs may read.

It is not my intention in this address to enter into the financial management of the gas business, for this must of necessity be worked out by the numerous corporations as is best fitted to the locality in which their business is conducted. I shall, therefore, pass this by and enter into a brief history of the origin of artificial light. And while this I know is not new to you, yet I hope I may interest you for a few moments. For this purpose I will necessarily have to quote from historical research which I have made.

First, we find that artificial light and heat were produced by the savage tribes by burning the branches of trees, shrubs, grass, etc. Then afterwards, splinters of resinous woods supplied the means of artificial light, and even unto to-day, A.D., 1900, this same means is employed in remote districts. Following this came torches and similar devices.

The use of lamps dates back to very early periods, the general opinion being that they were the invention of the Egyptians, of whom it is said they not only used them for common illuminating purposes, but also kept them burning in the tombs of the dead, as emblems of mortality.

The ancient Greeks were accustomed to the use of lamps. There were no set forms, but fat or oil was placed in any convenient vessel and burned by means of bundles of rushes or dried moss. Long after the ancients were advanced in the arts and manufactures, they continued to use these simple lights. Later we find many elaborate designs of vessels for holding the oils, but yet the simple wick in every case completed the arrangement.

The next we have to record is the candle as a scientific production. It is also of great antiquity, and it is said to have been often used as a rude indicator of time.

The lighting of streets, now almost universally adopted in cities and towns, was not known to the ancient Greeks and Romans, for we find it recorded that on their nocturnal revels torches or lanterns were carried before them by their slaves. Yet even in those days we find a few instances where public illuminations were indulged in. Rome was lighted on occasions of public games. The Jews illuminated the Holy City for eight days at the dedication of the Temple. London seems to have been the first city to adopt the idea of street lighting; for, in the year 1414, the citizens were ordered to hang out lanterns to light the streets, and it was made the duty of the watchmen to see the order enforced.

In 1668, when London began to improve her streets, or in the language of the present day, had "a boom," the inhabitants were reminded to hang out their lanterns at the usual hour for the safety of the city.

In 1716 an act was passed by the City Council of London requiring every householder whose house fronted the street to hang out at least one lamp, provided with sufficient cotton wick, so that the lamp would burn from 6 o'clock at night until 11 o'clock the same night, this order to be enforced by distress or otherwise on failure to comply with the act.

At the commencement of the present century street lighting was so defective in London that, in first class streets, every house had a lantern arranged in some manner at its entrance. Many of these were were still in existence as late as 1884 at the West End of London. At the time which I mention people did not know the worth of light; for while the streets were in such a miserable condition as regards light, the interiors of their dwellings were little if any better. Much more could be said that would make interesting reading, but I must pass and get a little nearer to our own day and time.

Coal from which gas has almost universally been obtained was first used, in London, by brewers, dyers, and others who required large fires, as early as 1306, but the smoke from it was considered offensive by the nobility and gentry. This, combined with the opposition from the medical profession, who declared it to be poisonous, caused a royal decree to be issued prohibiting its use under severe penalties; but in time as other fuels became scarce this prejudice gave way to utility and the use of coal was tolerated.

From the best authority at had I find that gas was first obtained from coal by Dr. Hales, in 1726; this, however, he only employed as a

means of amusement for himself and friends, as it is said he would fill a bladder with it, then, puncturing a small hole therein, he would light the issuing gas. But this was regarded as a philosophical toy without any view to utility.

From that date (1726) up to 1792, we find many scientific men turning their attention to the then important subject of artificial light, or illumination, until there was evolved the gas which we now use, and for which so many of the brightest men of the times have labored hard to perfect.

Gas, like all things of human origin, has ever had its enemies, many of them men who stood first and foremost among their fellows. For I find it recorded that such men as Sir Humphrey Davy and Sir John Banks were many years overcoming their prejudice against it. Napoleon is said to have ridiculed it, saying, "Cest une grande folie." Even Sir Walter Scott said, "The City of London would soon be in flames if such a visionary idea was attempted."

In 1820, Paris, that most enterprising of all cities, was first lighted with gas, but its enemies were more numerous than its friends; these, however, soon passed away, and words of praise took the place of fear and prejudice, so much so that one French author, in describing the then new light, said, "Where gas light is there is no night." "Where gas light is, there is continuous day." If this was so considered at that time what can we not say for it at the present time. I must here confess that no words if mine can in any degree give expression to the beauties and benefits of this wonderful light.

In a recent number of the *Western Electrician* I find these words: "One of the most interesting features of the great Paris Exposition is the lighting of the Champs de Mars, almost exclusively by the Welsbach gas lamps." This paper, a journal devoted to electrical subjects, says: "The illumination is superior to what one would expect." Continuing, the same journal says to electrical men: "The mode of exterior illumination which predominates on the Champs de Mars seems out of date, but judgment must not be passed too hastily, for the gas lamps which are used are of the highest order in ornamentation and efficiency."

On the advent of electricity many grave fears were indulged in by most of us who were then engaged in the gas business, but we soon recovered from this electrical shock. It was then we began to bestir ourselves. Those among the craft most learned took up the subject with more seriousness than ever before—especially was this the case in our own beloved country—so that now to-day we stand out to the world a shining light, in many respects in which none is more important than the comforts we have to offer to our fellow men in the matter of a first-class illuminant in the fair form of gas. But this is not all we have to offer and which we are supplying, for gas is used for many purposes other than light.

The food we eat is promptly and deliciously prepared for our table by gas. Many of our manufactories are propelled by gas engines, and even the electric light itself is dependent upon it for power to create the volt and the ampere. Large monied interests are engaged in the manufacture of these gas motors. Engines have been and are now being made of almost incredible power, some of them ranging as high as 1,500-horse power units in a single engine. On this subject you will have read to you a paper entitled "Some Notes on Larger Types of Gas Engines," by the first President of our Association, Mr. J. B. Crockett. The use of the gas engine enlarges the scope of the gas manufacturing business.

Then we are reminded that there is an ever increasing demand for gas for other fuel purposes. I dare to hope and believe that the day is not far distant when every house in every city and town will be furnished with gas ranges and gas stoves, and while the architect is considering the plumbing, wiring and gas fitting of every building, provision will *always* be made for gas heaters, gas ranges and gas stoves, as well as gas light. These are matters that we should in my opinion endeavor to bring more fully to public notice.

On this subject we are to have a paper from our Vice-President and former Secretary, Mr. John A. Britton, entitled "The Best Method of Introducing Gas Stoves."

As gas is now made from various kinds of material, we should not fail to give this Association and its members full benefit of our experience with each and every kind which we have employed. Especially should we at this time have something to say about the uses of crude oil, no matter if used for the manufacture of gas pure and simple, or for fuel purposes alone. We should be free to make full explanation as to results from this source. On this line we are to have a paper from Dr. R. M. Powers, entitled "The Use of Crude Petroleum for Firing Benches." Although I have not seen this paper, I am satisfied from the well-known ability of the author that it will be most valuable and interesting. Since the advent of oil in the manufacture of gas we have been obliged to use the steam boiler to a much greater extent than was the case when we made gas from coal alone; so that every gas manager is necessarily required to have a full knowledge of boilers and engines, as well as many other new appliances. On the subject of boilers, we are to listen to a paper by our much esteemed friend and early pioneer in the gas business, Past-President Theodore R. Parker, of Napa, entitled "Thoughts Suggested by Boiler Explosions."

And now that we can see bright days before us in the form of increased outputs we must be able to distinguish, and select the best and cheapest methods of manufacture. We must choose the appliances that have proven themselves most economical and most efficient, and we should be able to do this through the medium of this Association by passing along from one member to another the experiences which we have had with any method that we may have employed.

We shall have read to us while we are in session a paper that will no doubt be of great benefit to us all, and which will aid us in taking our choice of the best known processes that have been brought to light up to the present time. This paper comes from the thought and pen of no less a person than our distinguished friend, Mr. Alexander C. Humphreys, and is entitled "The Investigation of Gas Processes."

While we are entertained by the several papers already enumerated, we must not forget our chief clerk and accountant; who if properly cared for will made our own hearts glad, satisfy our customer (the public), and at the same time affect the pockets of our stockholders with plethora.

If you have not already recognized who the chief clerk and accountant is, you will be told by Mr. C. R. Collins, in a paper on the subject of "Prepayment Meters."

Our industry is one of growth, and to some extent of varied form. Less than a score of years ago we made gas almost exclusively from coal—a few attempts had been made to use other materials with indifferent success; but to-day this is not the case. Most of the large plants (and many of the small ones for that matter) on our Pacific Coast are using oil, some of them to the entire exclusion of coal, and some are using both coal and oil in combination. Hence, in order to be up-to-date and successful managers we must have a full knowledge of the nature of the gases. We must know of what they consist. Not only must we know this from analysis, but we must know it as a whole. In other words, we must know how to separate and how to combine them, so that we can best determine as to the product we are to send out for commercial use. In this connection we are to have a paper, accompanied by experiments and illustrations, by Mr. L. P. Lowe, taking as his subject, "The Synthesis of Commercial Gases."

As this very important subject is one that will without question interest you, I hope we shall have the usual good attendance while it is being read. In fact, I will say right here that you cannot afford to miss any of the papers, commencing this afternoon until the final adjournment; for these, together with the Wrinkle and Experience Departments, seem to me to make up an excellent programme; for the names of the several authors are guarantees of their merit.

The last, and by no means the least, treat that is in store for us at this meeting will be a lecture, by a gentleman who stands at the head of his profession as a mineralogist, on a subject of great public interest, and especially so to those engaged at this time in the manufacture of gas. You will see by the programme that Mr. A. S. Cooper, California State Mineralogist, will entertain, and I am sure instruct you, in a lecture on the "Physical and Chemical Characteristics of California Petroleum;" and while we are on this subject I am reminded that the product of oil is of vast importance, since it has been estimated that 220,000,000 gallons were used, in 1899, for gas alone.

Among the many letters which I have received from friends engaged in the gas business, not one of them would seem to indicate any lack of confidence in the future of the industry; but, on the contrary, all of them seem to feel very much encouraged and declare for expansion in the gas business. One of my correspondents (one that is first among his fellows on the Pacific Coast and first among the earnest workers of this Association) declares that the gas industry is as yet only in its infancy. If this is the case (and I verily believe it is) it is a lusty young fellow, and we will do well to encourage his future growth. That it is true there is no doubt, for new fields are opening up every day into which the producer of gas may enter with his product and there sow the seed of future prosperity.

On the whole, after looking over the field as far as I have been enabled to do, I must say we have a bright future before us as an industry.

Acetylene, of course, is still heard from; but, aside from an occasional explosion, no startling developments have been made. I do not say this in derision—not by any means. I am not one who despises the day of small things, for it has been proven too often that that which seems impossible to-day may become a great factor to-morrow.

As to garbage gas, of which we heard so much two years ago, I have heard nothing more; and, as a matter of fact, do not expect to outside of the largest cities. In the small interior towns there is no field for such an enterprise, for after the average (economically inclined) family have partaken of their meals, fed the cows, the dog and the cat, there is next to nothing left to escape in the form of illuminating gas.

The question of municipal ownership is yet before us, and while it is a live matter, as an Association I do not think we should deal with it, although as individual gas men we are more or less interested. I believe we have not so much to care for from that source now as we have had in the past few years, because a number of trials made by cities and towns have not all proved the success that their promoters had promised and believed they would be. Further, because our country has been in a more prosperous financial condition, there has not been that unrest and disposition to find fault. The hungry have been fed, the naked have been clothed, the idle have generally found work at remunerative wages, and satisfaction and contentment eagle-like have spread their wings over the entire land. Besides, the advancements that are being made in the science of artificial light require a great many changes which the people of a city or town are or will be slow to adopt; and on the other hand private corporations, being quick and ready to make use of any new devices that are found worthy, keep abreast of the times by giving the consumers the best that is to be had, with the result that the municipal plant soon finds itself out of date. Of course it is very important question and, therefore, cannot be dismissed by a mere opinion or a wave of the hand, but so much has been said and written on the subject, both within and without this Association, that I do not deem it best to go into detail. I have made the fight in my own town and in a small degree know what it means, even though we won and municipal ownership lost. But this, like many other things in the gas man's experience, has to be met and is met. Such things have the effect of arousing us and causing us to pay closer attention to our affairs and to the needs and wants of our patrons.

Under date of April 24th, 1900, I received a circular letter from Mr. Alfred E. Forstall, Secretary of the American Gas Light Association, asking me to take part in the International Congress of the Gas Industry that is to convene in Paris, France, next September. Personally, I am not able to do this, neither do I consider myself capable of contributing a paper; but it has occurred to me that some one among our number might be selected who could either attend or prepare a paper on some of the subjects outlined in the programme. It may be that some of our members intend visiting the great Paris Exposition about the time designated. In any event I am of the opinion that the Pacific Coast Gas Association should be heard from. I would, therefore, respectfully recommend that steps be taken to the end that we may be so represented.

As I pass along I feel that I must mention what, in this part of the world, is a comparatively new industry within our lines, and that is the coke oven process. Boston, Mass., seems to have been the initial city in this country to take up this process, and as the "Hub" is the center from which all the spokes radiate, until they terminate in the rim, *where there is no dead end*, we find that far-off San Francisco is a full segment of that rim, and is not to be behind the times in little matters of this kind. For, if the city papers are to be relied on, this sort of industry has already been inaugurated, a full account of which I had the pleasure to read in a recent number of the *Chronicle*. I sincerely hope this will prove a success.

At our last meeting you again chose Mr. Geo. H. Hollidge, of Merced, Cal., as Editor of the Wrinkle Department. To say that this was well merited does not half express it, for he has ever been an earnest and zealous worker for the welfare of the Association. It is indeed a task even to undertake this work, and a much greater one to complete it in his masterly manner. I hope that you have all encouraged and aided him during the last twelve months.

For the Department of Experience you chose Mr. O. M. Gregory, of San Jose, Cal., and while this is Mr. Gregory's first year in that line of service, I know he will be prepared to interest you, because, like Mr. Hollidge, he has ever been an indefatigable worker. As these two important departments have been of great value and concern to our Association, I would respectfully recommend their continuance.

Before I close I want to say a few words about the birth of this Association. It first saw the light on July 11th, 1893, at the office and in the Directors' room of the San Francisco Gas Light Company, at the corner of First and Natoma streets, in the city of San Francisco; consequently it will be just seven years of age at 10 A.M. to-morrow.

When our first Chairman read his paper, entitled the "Benefits to be Derived from the Formation of a Gas Association on the Pacific Coast," among the many good things in it I beg leave to quote the following: "The purposes of this Association are to promote not only a greater interest in the gas business, and thereby gain more knowledge, but also to bring the members of this Association together in friendly feeling, so that they will know one another, and they can ask questions that will educate one another and in that way be a positive benefit to every member of the Association. The benefit does not lie entirely in the fact that you are going to learn something. It lies also in the fraternal feeling which these meetings engender and cannot be but productive of a great deal of good."

That Mr. Crockett builded even better than he thought or hoped has been attested at each successive meeting. May this ever continue; may this Association be ever in favor of expansion in the gas business; may it continue in the good work outlined at its formation.

Before closing I desire to express my sincere thanks to one and all for your kind support and for the honor which you have conferred upon me. I especially wish to thank Mr. John A. Britton for the services he has rendered the Association and myself, and Mr. Grimwood for the interest he has manifested as Secretary during the past year, and to those of you here who have listened so patiently to what I have had to offer you.

COMMITTEE ON PRESIDENT'S ADDRESS.

When the President finished his reading, Mr. Parker appointed Messrs. W. A. Aldrich, M. C. Osborne and C. E. Burrows a committee to consider the address with instructions to report their recommendations thereon before the meeting adjourned.

The Secretary then read many communications from persons prominently identified with the gas industry regretting their inability to be present at the meeting, and wishing the Association all possible success.

On motion, the session was declared adjourned until 2 P.M.

[To be Continued.]

[From *Engineering News*.]

Electrolysis of Underground Metallic Structures.

[A paper read by MR. DABNEY H. MAURY, Engineer of the Peoria (Ills.) Water Works Company, at the last meeting of the American Water Works Association.]

Reports of electrolytic injury to water and gas pipes are rapidly accumulating from cities all over the United States, where the single trolley system has been in use for any considerable length of time, and the subject is one of serious moment to every corporation or municipality owning underground metal structures of any sort.

It is the purpose of the writer, after illustrating a few of the many instances of electrolytic injury which have come under his notice, to discuss the electrical resistance of the joints of cast iron mains, and to point out the important bearing which this joint resistance has upon all the various remedies for electrolysis heretofore suggested, and to show, from actual cases, the results which must certainly follow, if cast iron mains are used to convey electric currents.

The writer has been, since March, 1893, Engineer and Superintendent for the plant now owned and operated by the Peoria Water Works Company. Early in 1893, the water company's street foreman, Mr. W. B. Norris, reported to the writer that extra strong lead service pipes laid under the street railway tracks were bursting with a frequency that was remarkable, and that the appearance of the burst pipes was unusual, and different from that of any pipes the foreman had yet seen. Electrolysis, as occurring in water and gas pipes, was, at that time, almost unknown and very little had been published, even in engineering papers, regarding it. The writer at once suspected, however, the cause of the breaks, and the foreman was instructed to give him prompt notice of every such break, so that he could personally inspect the pipe and note the circumstance attending its rupture.

In order to better keep track of the injury, printed tags were prepared, as shown by the following:

Size and kind of Pipe.....
Service to No.....Street.
Length from main to curb.....
Date put in.....
Date repaired.....
Cause of repairs.....
Distance of break from center of Electric Railway tracks.....
Distance of main from center of Electric Railway tracks.....
Distance of stop at curve from center of Electric Railway tracks.....
Condition of Pipe at main.....
Condition of Pipe under tracks.....
Condition of Pipe between tracks and curb.....
Condition of Pipe at curb.....
Remarks.....
.....Inspector.

[The tag shown by Mr. Maury was an ordinary Dennison manila tag, about 3 x 6 inches, with the printed matter given above, but with extra spaces between each of the last six lines.—Ed.]

Whenever a pipe burst, the attendant circumstances were noted on these tags and the tags were signed by the superintendent, the foreman and the men assisting in the work of repairing the pipe. A sample of the pipe was saved for reference and the tag was attached thereto. Although a number of breaks occurred before these records were begun, and in spite of the fact that some intelligent laborers in search of lead for making joints in water mains appropriated and melted down a good many of our carefully preserved samples, records are still on file of 116 electrolytic breaks.

The bursting of service pipes continued with increased frequency, nearly always occurring on those pipes which passed under the railway tracks; for instance, on streets in which the mains were laid on or towards the south side of the railway tracks, 96 per cent. of the recorded breaks occurred in service pipes supplying the houses on the north side of the street and in pipes passing under tracks.

In investigating the cause of the destruction of our pipes, the query early suggested itself as to whether chemical action pure and simple could have caused the injury. To make clear the claim that the damage was done by the electric current, it seemed to the writer that some evidence should be found of redeposition of the metal supposed to have been removed from the pipes by the current. Our search for this additional evidence was soon rewarded, for early in March, 1894, we observed in the excavation made to renew a broken service pipe, that the lead taken away from the pipe was deposited in the form of glistening particles, or thin metallic coatings, on soil, sand and gravel, all through the adjacent earth, but above the pipe and in the direction leading from it up to the rails—the pipe at this point being shown by volt-meter tests to be electrically positive to the rails. In one excavation, where there was a well-defined wet streak along a fault in a clayey soil, the lead compound, afterwards identified by chemical analysis as sulphide, was observed along this wet streak as far as the sides of the excavation, or more than 6 feet from the pipe, the streak leading diagonally up from the pipe to the rails. A similar redeposition of the metal was observed in the case of wrought iron gas service pipes, and of cast iron gas and water mains, the joints of the latter being surrounded in nearly every case by soil stained with oxide of iron, while immediately in front of the ring of lead in the joint would be found a bluish metallic discoloration showing the redeposition of the lead. The writer sent samples of the soil thus impregnated with lead and iron compounds to Messrs. Stone & Webster, electrical engineers and experts, of Boston, and to *Engineering News* and to *Fire and Water*. The letters accompanying the samples, which were published in *Engineering News*, March 22, 1894, and in *Fire and Water* of about the same date, were, it is believed, the first published notes of such redeposition of the metals removed from underground pipes by the return street railway currents.

On March 30, 1894, the water company's steel standpipe on the West Bluff burst, killing one person and injuring 15 others, one of whom died later from his injuries. Upon examining the wreck of the stand pipe, the writer at once noticed a peculiar pitting of the inside of the vertical sheets, and the appearance of these pits was so different from that caused by any ordinary oxidation that he was soon almost positive that they were due to electrolytic action. A similar standpipe on the East Bluff was drained, and was found to be similarly pitted. The whole inner surface of the vertical shell appeared to be thickly covered with blisters resembling in outward appearance the tubercules sometimes found inside of old cast iron mains. This blistered covering, which was almost as thin as paper, was composed entirely of oxide of iron, and on brushing it away with the finger tips, the black paint with which the standpipe had been originally coated would be found beneath it. The black paint was oftentimes almost unbroken, or, at least, very slightly cracked. When the paint was brushed off, the pit would be disclosed, considerably smaller in area than the surface covered by the blister. The surface of the metal in the pit was perfectly bright and clean and its fiber was clearly discernible. Many of these pits were more than $\frac{1}{4}$-inch in depth. They were slightly more numerous in the West Bluff pipe than in the East Bluff standpipe and were in both generally larger and deeper on the lower courses of the vertical shell.

Fig. 1 is a photograph of the wrecked standpipe, the upturned corner of the torn sheet near the center of the picture showing the pitted appearance of the surface, the blisters having been, of course, shaken off by the fall of the metal and the metal itself having become somewhat oxidized before the photograph was taken. Fig. 2 is from a photograph of a small sample of steel from the standpipe and shows the pitting in the sheets around the edges of the rivet heads.

Fig. 1.—View of Wrecked Standpipe at Peoria, Ills., Showing Pitting on Upturned Piece, Due to Electrolysis. (The two largest blotches are streaks of mud.)

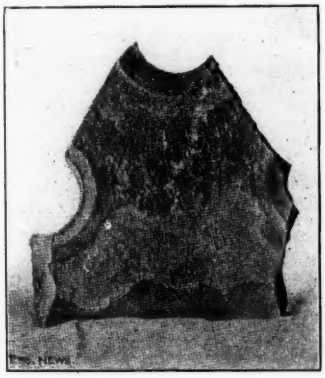

Fig. 2.—View of Fragment of Peoria Standpipe, Showing Pitting Around Edges of Rivet Heads.

It seemed advisable to secure a thorough expert examination with a view to determining the cause, nature and extent of the observed pittings on the standpipes, and injuries to the piping system. Messrs. Stone & Webster, of Boston, were selected to make this examination. The work, in which the writer, from time to time, assisted, covered seven weeks on the ground, and the reports submitted by Messrs. Stone & Webster fully confirmed the suspicions that the pitting was caused by electrolysis and established the fact that the entire piping system of the water company would be endangered by a continuance of the existing electrical conditions. The West Bluff standpipe was distant about 60 feet from the street railway line on Bourland street. The East Bluff standpipe was about 700 feet distant from the railway line on Knoxville avenue. Both standpipes were more than a mile from the power station, and were negative to the rails. The electrical examination relative to the standpipes was conducted mainly at the East Bluff standpipe, which was still in service. A flow of a part of the current from the railway line was clearly traced through the earth to the anchor bolts which held the standpipe to its foundation, as shown in Fig. 3, up these bolts and into the steel of the shell, and through the shell and from its inner surface to the projecting section of the 16 inch flanged cast iron pipe which served as both inlet and outlet, and which connected the standpipe to the water mains. The current was then traced along this pipe and along the mains to the power station. The deflections of the voltmeter needle were clearly traced to the railway current, being especially influenced by the one or two cars on the line beyond the standpipe on Knoxville avenue, and when the cars stopped running at night, the movement of the needle ceased. Where the current left the inner surface of the shell to pass through the water to the inlet pipe it made the pits already described.

Fig. 4 is from a photograph showing the interior surfaces of three sections of this inlet pipe, marked *A*, *B* and *C*, respectively, the positions occupied by these sections originally being shown by the letters *A*, *B* and *C* in Fig. 3. An examination of the photograph shows the strongly marked and numerous pits which were found inside the sections *A* and *B*, while the inner surface of the section *C* was found to be practically as smooth and perfect as though new. When the condition of the inside of these three sections of pipe was first noted, it

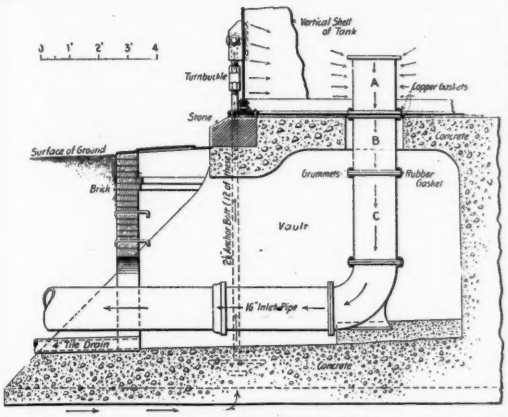

Fig. 3.—Partial Vertical Section of Peoria Standpipe, Showing Course of Electrica Current.

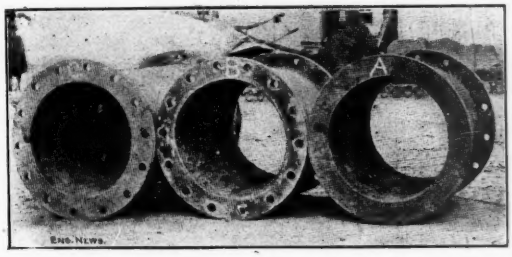

Fig. 4.—Interior View of Lengths of Inlet to Standpipe, Showing Pittings in *A* and *B*, and Effect of Insulation of *C*.

seemed hard to understand why *A* and *B* should be pitted, while *C* was unaffected. A closer examination, however, showed that in the flanged joints between the bottom sheet of the standpipe and *A* and *B*, respectively, corrugated copper gaskets were used, while the pipe *B* was separated from the pipe *C* by a thick rubber gasket; and that under the nuts and heads of the bolts holding the flanges together, there were grummets or wrappings of cotton wick soaked in tallow. The result of this arrangement was, that the current which entered *A*, after passing through the water from the inner side of the shell of the standpipe, and which was trying to return along the inlet pipe and water mains to the power station, encountered, at the joint between *B* and *C*, the rubber gasket and the grummets. The effect of the gasket and grummets was to practically insulate the section *C* from the sections *A* and *B*, and as none of these pipes were in contact with the ground, the current was compelled to leave the pipes *A* and *B* and travel through the water or along the slimy coating of oxide on the inside of the pipes around the joint between *B* and *C*, in order to continue on its journey. As the current was not leaving *C*, this pipe was not injured, but the current, in leaving the inner surfaces of *A* and *B* did pit them, as shown in the photograph.

These standpipes and the inlet pipes were negative to the rails, and are striking examples of electrolytic pitting under such conditions.

Early in 1898, Professor D. C. Jackson, of the University of Wisconsin, and Messrs. Stone & Webster, were requested to supplement the investigations already made by the latter, by another examination of the system, with a view of ascertaining whether the electrical conditions reported in 1894 still existed. The result of all these examinations and of those made, from time to time, by the writer, showed that the differences of potential between mains and rails had increased rather than diminished, while the number of breaks in the service pipes, and the number and extent of pittings in the mains, were very much greater than had before been observed.

With a view to further proving that the injury done to the cast iron mains and service pipes was caused by the electric current, samples of the graphitic substance dug out from the pits in the mains, and of the scale or incrustation adhering to the mains over the pits, and of the soils at various distances from the mains, and similar samples taken from the neighborhood of the lead service pipes, were sent to the University of Illinois, where they were analyzed by Prof. Arthur D. Palmer. Samples of ordinary soils, unimpregnated by the metallic compounds from the pipes, were also analyzed. These analyses showed that there was nothing in the soil which, except for the action induced by the electric current, could injure the pipes, while all of the conditions, as found by chemical analysis of all the samples submitted to Professor Palmer, were exactly such as would be caused by the presence of the currents complained of.

In 1899, a series of tests were made by Mr. A. A. Knudson, electrical engineer, of New York, in conjunction with the writer, at the site of the fallen West Bluff standpipe, in order to still further prove that when that standpipe was in service, there was an actual flow of current in the manner already shown by the previous tests at the East Bluff standpipe, by Messrs. Stone & Webster. The anchor bolts were still in the foundations, but the shell of the standpipe, as well as the 16 inch inlet pipe leading thereto, had been removed. It was necessary, therefore, in order to reproduce, to some extent, the actual electrical conditions that had previously existed, to connect a wire from the ends of the anchor bolts to the 16-inch water main in front of the standpipe. By connecting in a voltmeter on this wire, the variations of potential between anchor bolts and the water main were observed, and by replacing the voltmeter by an ammeter, the actual flow of current was measured. This current was clearly and positively identified as caused by the street railways, and the result of these tests fully confirmed the statement in the reports of Messrs. Stone & Webster, that the pits in the shell of the standpipes had been caused by the street railway current.

The joints of cast iron water mains often offer, as already stated, considerable resistance to the passage of the electric current, and the reason for this resistance is apparent, when the construction of these joints is studied. Cast iron water pipes are coated inside and outside with a preparation of coal tar that is an insulating material. In making a lead joint, the spigot end of one pipe is inserted in the bell end of another pipe and pressed home until it touches the shoulder in the bell. The spigot pipe is centered carefully, so that the annular space designed to hold the yarn and lead may be of equal width all around. The yarn is then rammed in home against the shoulder and holds the spigot in the center of the bell. There can thus be no actual contact between the two pipes, except where the very end of the spigot abuts against the shoulder of the bell. As both spigot end and shoulder are simply rough castings and are not turned, it follows that they are rarely in mechanical contact at more than two points, and on curves they can only touch at one point. In fact, it is frequently true that after the spigot pipe is once shoved home against the shoulder of the bell, and then released, it works away in the subsequent handling and yarning and oftentimes is not in contact with the bell at all. Even if the two pipes were in actual mechanical contact, the electrical contact would be poor, by reason of the two intervening coatings of tar or asphalt. In that portion of the joint occupied by the yarn, there is no contact between the two pipes and they are at this point fairly well insulated by the yarn itself, as well as by the two coatings. The rest of the joint is filled with lead, which is a conductor of electricity, but in between the ring of lead and the bell outside of the lead and between the lead and the spigot on the inside, are the two tar coatings which materially interfere with the electrical contact between the two pipes.

As it had been stated that the tar coating is completely consumed and burnt out by the heat of the molten lead when a joint is poured, the writer caused a joint to be poured and calked in the usual manner, and then had the bell sawed into three pieces, so that it could be taken off the spigot. It is needless to tell men who have had experience in laying and taking up water mains that the inner surface of the bell showed that the coating was entirely unimpaired by the heat.

Measurements were made by the writer in 1898 to determine the amount of resistance offered by the joints in cast iron water pipes, and also to ascertain whether pipes themselves showed any pitting as a result of this resistance.

A large number of these examinations were made during 1898 and 1899, and in every case the pipe which was of the higher potential was found pitted near the joint, while the pipe of lower potential, or that into which the current was flowing from the other pipe, showed much less electrolytic injury.

To further test the joint resistance and to determine, if possible, the influence of different methods of calking as affecting this resistance, the writer, in conjunction with Professor Jackson, caused a line of 6 and 4-inch pipe to be laid and supported on wooden blocks, so as to insulate it from the ground, as shown in Fig. 5. There were 27 joints in all.

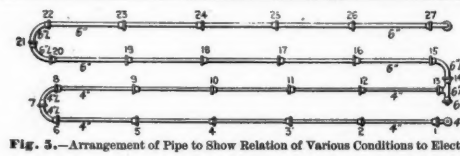

Fig. 5.—Arrangement of Pipe to Show Relation of Various Conditions to Electrolysis.

The pipe was new and had not been previously used. The calker was instructed to drive up the lead hard in one-third of the joints and to calk these joints in every way in the best possible manner, just as though the pipes were expected to stand the heavy pressure of the Peoria Water Works Company's system. Another third of the joints was calked not quite so hard, while the remainder were purposely only lightly driven up, the work being done as though carelessly, or by a bungler. A current of known strength was passed through the pipes, and the drop of potential around the joints was measured at points 1 foot apart, and was compared with the drop of potential in lengths of 1 foot of continuous pipe. These measurements were made at different times; first by Professor Jackson and the writer; then by the writer alone, and later by Mr. Knudson and the writer. The resistance of the joint was found, as shown by the table, to be from a few times to several thousand times that of the same length of continuous pipe, and this joint resistance was in no way affected by the manner in which the lead was driven up in the joint, some of the joints on which the best calking was done showing the highest resistance. The usual depth of lead in a joint in a cast iron pipe is about 2½ inches, but assuming the length of the joint at 4 inches, the joints in this line offered 89.2 per cent. of the total resistance of the whole line, or on the average the resistance of a joint was 227 times the resistance of 4 inches of plain pipe. In making this calculation due allowance has been made for the fact that the points of measurement around the joint were 1 foot and not 4 inches apart.

Results of Tests of Electrolysis on Experimental Line of Cast Iron Pipe Under Various Conditions.

No. of Joint.	Calking.	Current in Amperes.	Drop of Potential Around Joint in Volts.* Pipe Dry.	Pipe Full of Water. Clear.	Muddy.
1	Good.....		0.0056	0.0091	0.0087
2	"		.0039	.0059	.0048
3	"		.0046	.0066	.0059
4	"		.0095	.0134	.0122
5	"		.0042	.0070	.0058
6	Medium.....		.0080	.0140	.0124
7	Good.....		.0124	Off scale, hard.	Off scale, hard.[1]
8	Medium.....		.0034	.0050	.0044
9	"		.0069	.0145	.0153
10	Poor		.0022	.0038	.0033
11	"		.0016	.0028	.0022
12	"		.0041	.0063	.0049
13	Medium.....		Off scale, hard.[2]	Off scale, hard [3]	Off scale, hard [4]
14	Good.....	10	.0108	.0143	.0099
15	"		.0084	.0118	.0088
16	"		.0026	.0031	.0022
17	"		.0006	.0006	.0004
18	"		.0021	.0026	.0023
19	Medium.....		.0007	.0009	.0006
20	"		.0017	.0020	.0013
21	"		.0057	.0055	.0046
22	"		.0054	.0058	.0049
23	"		.0011	.0013	.0012
24	Poor		.0142	.0125	.0115
25	"		Off scale, hard.[5]	Off scale, hard.[6]	Off scale, hard.[4]
26	"		Off scale, hard.[7]	.0093	.0089
27	Medium.....		.0016	.0010	.0007

*Nine inches between points of contact.
Voltmeter showed: [1]0.042, [2]0.50, [3]0.520, [4]0.270, [5]0.370, [6]0.315, [7]0.40.

These observations, taken over a period of about 11 months, also showed that the resistance of the joints increased rapidly with age.

In Kansas City, Prof. Lucien I. Blake, of the University of Kansas, has recently made a number of tests of the joint resistance in cast iron mains. He found the joint resistance in three lengths of 6 inch pipe to be about 96 per cent. of the total resistance of the pipe and joints together; the joint resistance in the 58 joints of 687 feet of 6-inch pipe which had been 13 years in service, was found to be 96.2 per cent. of the entire resistance of the line; the joint resistance of 38 joints in 399 feet of 20 inch pipe was 88.2 per cent. of the total resistance of the line; and the joint resistance in 400 feet of 36-inch pipe was found to be 96.7 per cent. of the total resistance of the entire line.

Mr. Knudson found in Albany a pipe joint which showed a resistance 1,000 times greater than the resistance of an equal length of the plain pipe.

The injury caused by resistance at the joints is not so rapid at any one spot as the injury where the current leaves the pipe for the rails in the positive area, only because all of the current carried by the pipe does not flow around the joint. But one ampere of current, leaving the pipe for the power house in the positive area, pits the pipe but once at that point, while one ampere of current flowing along the pipe and around joints in either the positive or negative district, pits each length of pipe near every joint, where it leaves it to flow around the joint; so that the total injury caused by this ampere is cumulative, and may be, in the aggregate, hundreds of times as great as the damage caused by the same ampere of current where it permanently leaves the pipe.

The effect of the current on the rail joints of a single trolley system is similar to that on the joints in the water mains. Within the past three years the writer has examined many hundreds of rail joints, and it was always easy to tell from the appearance of the rail ends, and of the chairs, when the rails were laid on chairs, which way the current was flowing. The end of that rail which was next to the power station would show little or no injury, while the end of the other rail, or that having the higher potential, was invariably pitted. Fig. 6 is reproduced from tracings from the bottom flange or base of such a rail end (and also from two rail chairs), the solid line showing the shape when the tracing was made, while the dotted line shows the original shape of the rail when it was new and before it had been eaten away by the current. Fig. 6 also shows the bottom portions of two rail chairs. The chair *B* was taken from the side of the joint away from the power station. The dotted lines show its original shape. The chair *C* came from the other end of the same rail, on the negative side of the joint, and shows no perceptible injury.

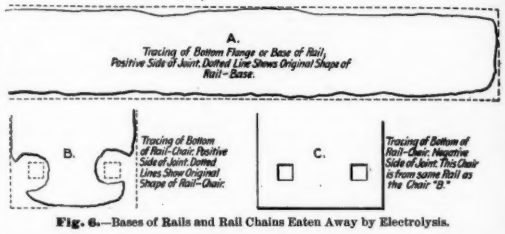
A.
Tracing of Bottom Flange or Base of Rail, Positive Side of Joint. Dotted Line Shows Original Shape of Rail—Base.
B.
Tracing of Bottom of Rail-Chair, Positive Side of Joint. Dotted Lines Show Original Shape of Rail-Chair.
C.
Tracing of Bottom of Rail-Chair, Negative Side of Joint. This Chair is from same Rail as the Chair "B."

Fig. 6.—Bases of Rails and Rail Chairs Eaten Away by Electrolysis.

Fig. 7 shows two rail chairs and a fragment of a third chair secured by Mr. Knudson and the writer. The chair, *A*, was a sample of a large number of similar chairs on the high potential side of the joint, and its thin and wasted appearance is plainly shown. The fragment, *B*, was broken by hand from another similar chair. The chair at *C* was from the same piece of roadbed, and is a fair sample of a number of chairs observed near the low potential side of the joint. This chair, as the view shows, is almost as good as new.

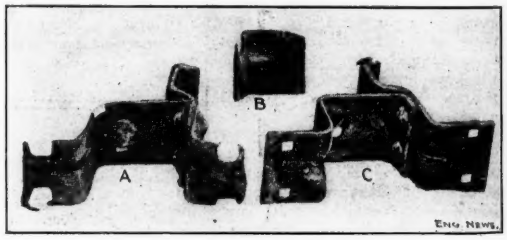

Fig. 7.—Views Showing Effect of Electrolysis on Rail Chairs.

The soil around the outside of a water main offering an easier path for a current than the water or slime on the inside, outside pittings are more numerous and generally deeper, and they are much more easily observed. The pits on the outside may be caused either by current which leaves one length of pipe to go around a joint into the next length of pipe, or by current permanently leaving the main for some other conductor of lower potential, such as rails, or wires leading to the dynamo; but the inside pits cannot be caused by anything except

resistance in the line of pipes itself at the joints, as nothing else could make the current leave the metal of the pipe and travel through the water. Opportunities for observing these pits have heretofore been rare, as the action is naturally slower inside the pipe than outside, and as it is necessary for some one familiar with the effect of electrolysis to be present and actually examine the pipe at the time when it is removed in order that the pits may be identified.

The pittings in the 16-inch inlet pipe to the West Bluff stand pipe, observed in March, 1894, and inside pittings found by the writer in a 20-inch cast iron main in 1896, are believed to be the earliest examples of this injury noted, but numerous instances have since been reported.

Figure 8 shows a joint of a 12-inch cast iron main on which the current was flowing from *A* to *B*. The very serious outside pittings, nearly ½-inch in depth, are plainly shown on the pipe *A*, while the pipe *B*, on the other side of the joint, was, near the joint, almost uninjured. The surface of the lead in this joint was deeply pitted in places and so much of the metal had been removed that the marks of the chalking tool all around the joint were entirely obliterated. The pipe *A* was also pitted in a number of places on the inside, while no pits were found on the inner surface of the pipe *B* near this joint.

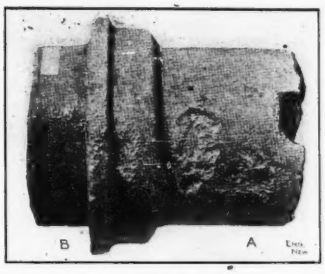

Fig. 8.—Electrolytical Pittings on 12-inch Cast Iron Water Main. (Current Flowing from *A* to *B*.)

Mr. A. A. Knudson found deep outside and inside pittings in Albany, in 1899, as shown in the view, Fig. 9.

Fig. 9.—Electrolytical Pittings on Inside and Outside of 4-inch Cast Iron Water Pipe, Albany, N. Y.

Professor Blake, from recent examinations in Kansas City, writes as follows:

A 12 inch pipe running at right angles to an electric railway, and which was negative to the rails, was found to be carrying a current of varying strength and delivering it into a 36-inch main some 750 feet distant.

Electrolytic pittings were found on many sections near the joints, only on the positive side, where the current was shunted around the joints. Some of the pittings were ½-inch deep. The interior of the pipe could not be examined.

Again, a length of 6 inch cast iron main was taken up in another part of the city and internal electrolytic effects were apparent near the joint. A chemical analysis of the material dug from the pits gave 22.3 per cent. graphite, 49.7 per cent. iron.

A second length was removed and broken into, and a fresh fracture revealed the internal electrolysis, by the discoloration of the iron where the pitting was taking place, and which was already ½-inch deep, beginning from the inside. A number of similar cases were discovered, and are convincing proof that cast iron mains cannot convey currents without electrolytic damage, when those mains form part of the return circuits of electric railways.

Within the past few months the writer had occasion to remove from the ground a 16-inch cast iron main. This main was negative to the rails and was nearly 2 miles from the power station. It lay at right angles to the tracks, and the portion removed was distant, at its nearest point, about 150 feet from the rails, and at its further end, 570 feet from the rails, there being 420 feet of pipe removed. Measurements with voltmeter and ammeter showed a current flowing along this pipe from the rails towards the west soil of the river bank, in which the further end of the pipe was buried. Every length of pipe showed electrolytic injury. In one pipe the bead in the spigot end had been eaten off for two-thirds of the circumference of the pipe, and in one place the entire thickness of the pipe was eaten out for nearly an inch in depth from the end. There were both outside and inside joints pittings, always on the positive side of the joint, and no pits at all could be found anywhere else on this pipe.

In a recent paper, Professor Blake states that observations and experiments prove that the effects of electrolysis upon water pipes are not limited to the so called "danger areas," or districts in which the pipes are electrically positive to the rails. He goes on to say:

Resistance at the joints in cast iron pipe is sufficient at most joints to shunt a portion of any current allowed in these mains, around the joints through the soil outside or water inside, or through both. Then on the positive side of joints, the effects of electrolysis, both external and internal, are to be apprehended.

Professor Blake then gives in detail the tests previously referred to as made by him to determine the joint resistance, and closes by giving the forcible and convincing examples already quoted of the disastrous results of allowing cast iron mains to convey electric currents.

It must be clear to any one who has seen the evidence of injury caused by the return currents, and who has studied the effects on the water mains at the joints, or at any other point where the current, once on the pipe, must leave it, that the owners of such pipes can do nothing to prevent the injury.

Street railway companies have frequently recommended that the pipes themselves be connected by wires to the negative bus-bar of the generator, or to the rails at various points, or to overhead or underground return feeder wires—thus diminishing the resistance of the pipe system as a conductor, and lowering the potential of the pipes usually in what has been termed the "danger district" or the region where the pipes are shown by voltmeter to be positive to the rails. But all such methods contemplate using the pipes to convey the electric current, and they all invite more current to the pipes at some part of the system.

It would undoubtedly be a fine thing for the railway companies to have the conductivity of the pipes on which they already rely largely for the return of their current, still further increased. It would mean smaller coal bills in the power station and less outlay for construction and maintenance of their own return circuit. It would, also, apparently lessen the rapidity of injury to the pipes in the "danger district," and, by stopping temporarily the number of actual breaks at the points where they have been occuring with greatest frequency, it would stave off the day of reckoning with the pipe owners. But the general pipe system would be carrying much more current, and, as the pitting goes on, at or near the joints, wherever a main is carrying current, either in the positive or negative district, it would mean that, while the injury in the "danger district" would not be so rapid, the whole system would be much more generally attacked, and that by the time a bursting pipe at length called attention to the injury at some point remote from the power station, the entire pipe system would have been seriously injured. Equally impracticable and misleading are the suggestions for maintaining the pipe system at equal potential throughout, and for "insulating sections" or "insulating joints," some of which have been patented. The idea of these sections or joints, as advanced by their advocates, is to break up the metallic continuity of the pipe line and reduce its conductivity, and thus prevent its serving as a path which the return current would naturally choose. The effect of thus dividing a pipe system into a small number of sections would hardly be worth considering, as the ground itself is a good conductor, and the cur-

rent would leave one section only to go to another, passing through the earth around the insulating joint just as it does around the lead joint in a cast iron main. To entirely destroy the conductivity of the pipe line, it would be practically necessary to make it up entirely of insulating sections, which, as non-metallic substances are not generally recognized as good material for underground water pipes, and for other equally obvious reasons, would be absurd. The conductivity of the tracks may be, of course, increased by the use of heavier rails, heavier bond wires and improved methods of bonding, or by the introduction of welded joints, or by making practically continuous rails; but the continuous rail itself is at best but a palliative of the electrolytic injury. The rails are not insulated from the ground, and the pipes would still carry, and be affected by, a large portion of the current, as is clearly shown by numerous electrical surveys and reports of serious damage in cities where the best tracks known to modern science are in use.

What, then, can be done to entirely remove the cause of the injury? The answer is simple. Keep the return currents out of the ground.

This has been successfully accomplished in this country for years, by two methods. In Cincinnati, and in Washington, D. C., the double overhead trolley is in use, while New York, and Washington have been the first to adopt the conduit system. In this system, both the outgoing and the return conducting wires are laid in a conduit under ground, electric connection with the motors in the car being furnished by two contact pieces or "plows" running under the car in a slot resembling that of the old cable roads. The supply wire, as well as the return wire in the conduit, is carried on insulated supports. Both the overhead and underground systems have proven successful in practice, not only in entirely preventing electrolysis, but in what is naturally of far more importance to the street car companies, in the general economical details of operation and maintenance. The conduit system is, of course, more expensive to build, and is peculiarly adapted to the larger cities.

The Cincinnati overhead double trolley system comprises about 220 miles of track. The conditions of its operation are unusually trying, among them being narrow streets, grades sometimes as high as 12½ per cent., and, in places, especially near Government Square, a multiplicity of intersecting tracks such as is, perhaps, not equalled in street railway construction anywhere else in this country. Every car on the system, at some time in its regular trip, must pass over one of the tracks at Government Square, and to stand during the busy hours and watch the perfect ease and smoothness with which the hundreds of cars thread this maze of tracks, at times at intervals of only 4 or 5 seconds, is always most interesting, and will convince even a skeptic of the mechanical practicability and success of the double overhead trolley. After 10 years' experience with this system, which has been voluntarily adopted and developed, its owners and managers declare that the cost of operation and maintenance is less than it would be with single trolley.

The double trolley is safer than the single and the difference in appearance between them is trifling. All connections are in plain sight overhead, and are always accessible for repairs. No lightning arresters are needed. No excavation of street or pavement is required to renew rail bonds, as the rail bonds themselves are no longer needed; while for hill climbing, in bad weather, the double trolley is far more efficient, since both rails may be sanded, while in the single trolley system, one rail must be kept clean, in order to keep electric contact between wheel and rail, thus diminishing the fractional grip of the wheel on that rail, while the sanded rail is, at the same time, nearly useless as a conductor.

In Washington, D. C., all roads within the city limits are required by law to have a complete insulated underground metallic return for their current, and by recent acts of Congress, passed on account of electrolytic injury caused by the single trolley systems, the overhead double trolley is required in all other new or amended charters, within the District of Columbia.

In systems recently constructed in London, the double trolley is required by law, and the cars are accordingly running under that system.

The cost of changing a street railway system from the single to the double trolley is so small as to be insignificant when compared with the enormous interests endangered by the continued use of the single trolley system.

ADVICES from Joliet, Ills., are to the effect that the proprietors of the Joliet Gas Light Company will rebuild that plant, providing they can secure title to certain property at the foot of Division street. As this title will certainly be obtained, the improvements may be looked upon as a surety.

Alternating Current Generators.

[From a paper read by MR. H. G. HEIST, at the last convention of the National Electric Light Association.]

Since the general introduction of alternating current followed the extensive use of direct current machinery, it was very natural that the same type and method of construction used in the latter should be adopted, and revolving armature generators resulted. With the small sizes which were at first built and the moderate potentials of that time, these machines were satisfactory and there was little reason for any change; but with the development of the art, various improvements and modifications suggested themselves, one of the most important being the introduction of machines with revolving fields. These machines offer many advantages of construction and operation, and are rapidly displacing the machines of the older form.

The regulation of the potential of alternating current machines has always been an interesting problem and one for which a solution has been eagerly sought for some years. There have been various steps in solving this problem that may be briefly traced with interest. The first machines were separately excited, but it was soon found that some form of automatic regulation was desirable, and methods of compounding were devised. This was done either by rectifying the line current or a current derived from a series transformer in the main line. For a load with a uniform power factor, this method of regulation is quite satisfactory, but with a mixed load of lighting and induction motors it leaves much to be desired, since if the machine is adjusted to regulate for a load of one kind, it will either over-compound or under-compound for the other condition. If the machine is adjusted to give the proper potential at the end of a line with a lighting load, it will be too low if motors are added. If adjusted for a motor load, it will be too high if lights are operated alone. It was with a view of rectifying difficulties of this sort that the compensated machine was devised. This was so named because it compensates or equalizes for loads of variable power factor, and will give the potential that the machine is adjusted for—whether the load is non-inductive or whether it is an induction motor load or a mixed load—*i. e.*, you may have a load consisting entirely of lamps and the machine will compound to 2,300 volts at full load, or you may have a motor load and the same potential. The same is true if the load consists of half lights and half motors—always with a given load the potential at the generator will keep constant. This is a feature of very great value, as will be appreciated by all who have operated alternating current apparatus.

As stated above, the earlier alternating current generators were usually built of the revolving armature type, the first machines having the winding placed on the surface of the smooth core, but later it was placed in slots of the then so called ironclad armature. This allowed of the use of entirely enclosed armature coils, thus making possible an insulated covering of a quality unknown in earlier dynamo construction, but the supporting of the coils on the revolving armature either by bands or by clamps or shield rings of various sorts was always a troublesome matter. The collector rings for the higher potentials have also been a detail to which there was considerable objection, both on account of the difficulty of constructing rings satisfactorily insulated for higher potentials and also on account of danger to the attendant. It is unusual to find machines having a higher potential than about 3,300 volts of the revolving armature type, largely for this reason. For very low potentials, on account of the large current to be taken from the collector rings, the revolving armature machine is also not suited.

With the introduction of revolving field generators, many difficulties that are inherent to the revolving armature machines have been overcome and a construction much more satisfactory in every way has become possible. We are now enabled to produce machines which have stationary armature coils which require comparatively little fastening in the armature and which may be wound for all potentials from the lowest to 12,000 volts or more, with entire satisfaction. In the case of high potential machines, the terminals are usually entirely enclosed so that it is impossible for the attendant to be injured by them either from carelessness or accident. On low potential machines the feature of having stationary armature coils is just as desirable since the current is led through stationary parts only and does not have to pass through brushes. The coils of the armature are wound directly into their final shape and then filled with insulating compound. The insulation consists of a number of layers of tape, the number varying with the potential of the machine, each layer being carefully coated with varnish, thus making a coil insulation practically airtight and waterproof. On high potential machines the insulation is so important a matter that it is usual to put only one coil in each slot, and also to

reduce the number of slots per pole so that the total percentage of space occupied by insulation is not too great. This produces a winding in which there is more than one shape of coil. On smaller machines the so-called "barrel" winding is generally used, because such machines are built of lower potentials—generally 2,300 volts.

In this case only one kind of coil is used, and when the coils are placed in the machine they produce a very symmetrical structure. The armature coils are held in place by wooden wedges which are easily removed and form a thorough protection for the coils in case foreign matter should accidentally find its way into the air gap. The advantages of stationary coils are very great as they are not subject to injury from mechanical strains produced by centrifugal force. There are no bands, so their removal is a very simple matter, and lastly, the ends are free to the air on all sides instead of being bound down to a supporting head. On larger machines it is usual to arrange the armature so that it may be slid on rails in a direction parallel to the shaft until the armature and field are free from each other and either part is rendered accessible for repairs or cleaning. The extra space required for this purpose is usually very small since a part of it is always necessary for the collector rings supplying current to the revolving field. The armature core is usually built up of the best quality of thin sheet iron carefully annealed and the laminæ insulated from each other by paper or japan.

The revolving field structure is a detail which has received some of the best thought of electrical designing engineers for the past few years. The pole pieces are made of punchings of heavy sheet iron about $\frac{1}{8}$" in thickness, with a composition end plate, the whole fastened together by means of rivets, or in some cases with bolts. These pole pieces are fastened to the field ring by two methods—in belted machines by means of a projecting dovetail on the pole piece which enters a groove in the field ring, and is secured by keys with a very slight taper, so that by light blows of the hammer on this key a very secure fastening is obtained. In the case of slow speed machines where the centrifugal force is less and the diameters of the field rings greater, more lightness and sufficient strength is obtained by fastening the poles by means of bolts. Except in the very small machines, the field copper consists of a flat ribbon wound on edge, so that the coil is only one layer in depth, the outside surface of which is bare. Every turn is thus exposed to the surrounding air, and it is impossible to have a coil warm on the inside. The surface of the coils being flat gives large bearing of the turns of the coil on the insulation, thus not allowing any opportunity for the windings to shift on each other and short circuit. The turns are insulated from each other by sheets of paper. These coils form a striking contrast and improvement when compared with field coils of machines built heretofore.

By somewhat enlarging the diameter of the armature, the yoke of the revolving fields can readily be made large enough to serve as a fly wheel for the generator. This, while making the cost of the generator somewhat greater than if a separate flywheel is used, still offers many advantages so that it will probably soon be the usual construction of the engine driven alternators. Some of the advantages of this form of construction are that the shocks due to sudden changes in load are directly transmitted from the pole pieces to the flywheel mass, and not as with the older construction, through the arms of the dynamo spider, through the shaft, then out through the flywheel arms, the total weight of the parts on the shaft may be reduced, since only one hub and spider is required; the length of the shafts may be greatly reduced, thus also reducing its diameter, and the size of foundation and space occupied by the machine. This construction moreover makes a more compact and symmetrical piece of machinery than if a separate flywheel is used.

The above general remarks on revolving field generators apply equally to the line of compensated machines which has been developed by the General Electric Company, and to which I would like to call your attention. These machines so far have been built belted only, and the exciter mounted on the shaft of the revolving field, and in their design all the best features of years of experience have been incorporated.

The exciter of one of these machines has the same number of poles as the generator. They are wound for 60 volts on smaller machines and 125 volts on larger ones. The poles are stationary, and the armature revolves as is usual in direct current machines. The construction of the exciter is the same as in direct current multipolar machines only on account of the small energy necessary for exciting, the parts such as the pole pieces and armature coils are very small. There are three taps in the exciter armature which are connected to collector rings on the shaft—on the smaller machines on the outside of the bearing and on the larger ones, between the bearing and the armature. The exciter is placed within the shield of the alternator which allows a construction to be used that does not destroy the symmetry of the machine and affords protection for the exciter. For direct connected machines the exciter is mounted on the outboard bearing of the engine and is driven by means of enclosed gears. In this way an exciter may be used with a smaller number of poles than is used on the generator.

The machine is entirely equipped with carbon brushes, and in all cases there are at least two brushes in multiple so that any brush on the machine may be examined, cleaned and replaced while the machine is in operation.

The bearings used in these machines are the usual spherical self-oiling, self-aligning bearings made of a heavy cast iron sleeve lined with anti friction metal. The bearing next to the pulley is made especially large, both to ensure stiffness of the shaft and to avoid wear and heating. The small bearing next to the exciter has only very light pressures on account of the long distance between bearings. The arrangement which has been adopted on these machines allows the bearings to be placed far apart—yet keeping the machine as a whole very compact, which is a very desirable feature on machines with two bearings. The oil rings of all the larger bearings are made split, so that they can be readily removed without taking the shaft out of the bearings if it is desired to do so.

It is well known that when the load on an electric generator, direct or alternating, is increased, the potential will drop unless the field excitation is also increased. This is due to the resistance of the armature, the inductance of the armature, and the reaction of the armature on the field poles, the latter reducing the amount of effective magnetic flux. The potential at a distant point, where the current is used for lights and motors, falls even more on account of the resistance and inductance of the line. To compensate for this D.C. dynamos have been compounded by passing the main current through series coils on the poles and so adjusted that the potential at the machine increases with increasing load. On alternating and multiphase machines the same result has been obtained by rectifying the main or an induced current, and using it for the same purpose; and, except for a slight increase in complication, the method is just as effective as on D.C. machines, so long as the alternating current is in phase with the potential, which unfortunately is rarely the case in ordinary operation, since partly loaded transformers and induction motors produce a lagging current which requires a greater field excitation to produce the normal potential. Thus, in all types of alternators heretofore designed the compounding required for non-inductive load has been entirely insufficient for inductive conditions. With the loads that ordinarily have to be provided for on alternating current circuits, there are wide variations in power factor, especially in case where considerable proportion of the load is in motors. Therefore, the introduction of automatic means of field adjustment for all kinds and degrees of load is of the greatest practical value. This is what is being obtained by this new method of excitation, which is based on a radically different principle from anything that has heretofore been employed and gives an automatic compounding far superior in results from that which can be obtained by any other known method, and at the same time there is nothing but the simplest and most reliable mechanism used, in fact without any mechanical change or adjustment. The devices by which this result is accomplished are mechanically simple. The shaft of the alternator which carries the revolving field also carries the armature of the exciter. The exciter has the same number of poles as the alternator, so that the two operate in a synchronous relation. Besides being connected to the commutator, which delivers current to the field of the alternator and to the field of the exciter, the winding of the exciter armature is connected to three collector-rings. Over these collector-rings it receives current from one or several series transformers inserted into the lines leading from the alternator. This alternating current passing through the exciter armature reacts magnetically upon the exciter field in proportion to the strength and to the phase relation of the alternating current. In consequence thereof the magnetic field, and hence the potential of the exciter, is due to the combined effect of the shunt field and the magnetic reaction of the alternating current. The connections between the armature of the two machines are so made that the poles induced in the exciter armature are somewhat ahead of the exciter field magnetization, but still so that they will assist the field magnets. The result is that with increasing current the current passing through the exciter armature strengthens the exciter field and thereby the field of the generator. If the current lags, as under an inductive load, the poles produced by the alternating current in the armature come more nearly in line with the exciter field poles, thus strengthening the field more with a given line current. This is so ad-

justed as to give the necessary rise of exciter potential as the non-inductive load increases and without other adjustment to give a greater rise of exciter voltage with additional inductive load.

These generators may be used very satisfactorily as single-phase machines for a lighting load on two lines and motors placed between the lighting terminals and the third wire. In this case the machines are adjusted so as to give a correct potential on the lighting circuit, whether the load is due to a lighting load or to a motor load. For small stations this is a very desirable method of installing a plant as only a single lighting circuit is necessary, and the attention given to the machine can be reduced to a minimum. A second method of installation which has found considerable favor of late is to install a 240-volt generator, which is Y connected, and which has a fourth wire brought out from the common connection. The lights on a machine of this sort are placed between the neutral wire and the three terminals of the machine, arranging the lamps so as to approximately balance the load. This, however, is not very essential as the unbalancing effect with this arrangement is almost negligible. For factory distribution work this is a very convenient arrangement, as no transformers are needed, and the power and lights are distributed from the same circuits with a minimum amount of copper, and with almost perfect regulation. The usual method of distributing a general system of lights from three phase generators is to transmit the current over the line by means of three wires, and to transform with the transformer primaries connected delta and the secondaries Y, connecting the Y-con nections with a neutral wire, and the whole to a system of secondary mains, and approximately balancing the lights in each important installation. In this way a very efficient distribution of the power is obtained with a minimum amount of copper and the generators are used to the best advantage as all branches are fully loaded and motors can be installed at any point. In large installations it is usual to have potential regulators in each branch to take care of slight unbalancing that may occur. These regulators may be made to operate automatically, keeping the constant potential at some distant distributing center, if it is so desired, or at the station. Two general types of potential regulators are used for this purpose. The magnetic regulator, which is used in smaller sizes up to about 6 kw., and the compensator regulator, which is used on large sizes. In connection with the compensator regulator, an ingenious switch has been devised which snaps from point to point, carrying current momentarily through an arc which, however, is interrupted immediately when the second contact is made.

Another use to which this machine can be put is in the operation of series enclosed arc lamps, which are so largely coming into use at the present time in connection with the constant current transformers. Here the load is quite inductive, and it is hard to operate with incandescent lights without hand regulation, but the machine takes care of such loads perfectly.

In conclusion I will say that I have seen a 75 kw. belted machine start a 50 horse power induction motor belted to another machine, so that it had a considerable load with a fluctuation so brief on the lights as not to be noticed unless it was especially looked for, the voltmeter needle swinging perhaps five volts for a very small period of time—say $\frac{1}{16}$ of a second, coming back again to its normal voltage, or in fact, to a higher potential than before, on account of the compounding, in a surprisingly short time. On observing the tacheometer on the generator under these conditions, it was found that it also fluctuated, possibly to the stretching of the belt as the load was put on; thus my conclusions are that there would be actually no fluctuation under these conditions with constant speed.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, July 10, 1900.

Concerning the Association, the Institute, the Institution, the Society, and the False Prophets.

The first annual meeting of the British Association of Gas Managers was held in the year 1864, on a much smaller scale than would to day be considered satisfactory for a District Association meeting. But it at once commended itself to gas managers, and from a small beginning soon blossomed forth into very respectable proportions. It was essentially a Gas Managers' Association, and posed as nothing more, the business being confined to the holding of annual meetings. The number of members increased year by year, until at the period of the change of title to the "Gas Institute," in 1881, there were 750 names on the books, and it could claim to be a national representation of British Gas Managers. In 1876 came the rumors that the end of gas was in sight, and that a few years would see it replaced by the electric lamp. About that time a marked change was noticeable in the matter of public credulity. Previously the tendency was to discount all new claims. We all know how the prospects of coal gas were received. Yet the sons of the men who sturdily refused to accept the possibility of a light without a wick, and who begged George Stephenson not to risk the commercial stability of his proposed railways on absurd claims of being able to travel at 30 miles an hour, eagerly jumped at the story of an electric lamp that would be about 10 times cheaper than gas. A large number of gas stockholders were infected by the prevailing mania, and under its influences parted with their property on terms that subsequently proved a continual source of annoyance and regret. Under these circumstances it was thought that the Association might be expanded to represent not only gas managers, but the whole industry. Looking at the immense amount of money invested therein, some of the members thought that with the aid of a merely nominal contribution, either from the companies or from stockholders in their individual capacity, the Association might become an important Institute, having its own headquarters in London, a reference library, a laboratory, and even an experimental gas works, capable of dealing not only with technical questions, but with all financial, legal, and commercial matters concerned in the administration of gas, from the retort house to the burner. Questions relating to the design and manufacture of gas burners, stoves, engines and all gas consuming appliances were to receive special attention. All anticipations of this kind proved as illusory as the threats of extinction that to some extent originated them. The Institute made a grand start with the Crystal Palace Exhibit, in connection with which an elaborate series of experiments on gas heating and cooking stoves was carried out with results that proved very helpful, and greatly increased the use of gas for these purposes. There was also some research on condensation, and a little dabbling with photometry and with other matters of general interest. But events proved that the financial element did not take kindly to the Institute. While at times of apparent urgent necessity they did not object to guarantee a subscription for a special purpose, they did not care to support a general fund. They wanted to see what was going to be done with the money before they would agree to pay it, while the Institute could not do much unless they received the funds in advance. Certainly about 20 gas undertakings became annual subscribers, and the Institute is indebted to the public spirit of a few members of the financial interests to the extent of about £85 per annum. But it can scarcely be claimed that the Institute succeeded in defending its title. To all intents and purposes it remained the old Association, depending for support on the old Association element.

Unfortunately the Crystal Palace Exhibition was the means of introducing an element of discord into the hitherto outwardly harmonious relations of the members of the Association between themselves. Or perhaps it would be more correct to say that it was the means of fertilizing used which already existed, and indeed is always present in any society that numbers its members by hundreds, in the form of little cliques, personal jealousies and private disagreements, but which usually have but a brief existence and die a natural death. But these differences, although they concerned but a few and were in no sense important to the bulk of the members, cropped up year by year until at last a majority of the Council took the view that the only way out of them was to dissolve the Institute, and accordingly resigned their seats. But a minority of the Council desired that the Institute should be carried on, and with true British pertinacity succeeded in doing so, and were supported in their endeavor by the majority of the members, who, while not objecting to reasonable reforms, were decidedly opposed to more drastic measures. The result of all this was the secession of about 150 members from the folds of the Institute, and this malcontent flock immediately set to work to establish an Institution of Gas Engineers that should possess all the advantages of the Institute and none of its defects. The first meeting of the Institution was held in 1891, and since than it has ran a fairly easy and placid course. It now numbers about 240 members, of whom, however, nearly one-half retain their membership and connection with the Institute. The formation of the Institution was an occasion for more prophesying. It was freely suggested that the advantages offered by the new body were so evident that there could be only one conclusion. There would be a gradual secession from the Institute to the Institution, until at last the former could not be carried on. But all this proved as fallacious as the forecasts of the extinction of the gas industry, and of the glorious future of the Gas Institute. As a matter of fact the parent body staggered a

little for a year or two, and then steadily settled down on the old course, and continues to carry on a prosperous existence under the support of the old Association element. The membership is well maintained, and stands at the present time at about 700.

This somewhat lengthy prologue is necessary to a clear understanding of the position of affairs at the recent meeting of the Gas Institute, which was held in London last month. With so large a proportion of the Institute element in the Institution, and with the notion of a representative body floating about—though I do not know that there is much more in the word "representative" then there is in that blessed word "Mesopotamia"—it is natural that negotiations should be promoted between the parent and the rebellious child. If, for no other reason, it is much more costly to keep two Associations going than one, and there can be no doubt that one body is capable of doing all that is done by the Institution, as well as and in addition to carrying on the work of the Institute. As the result of a great deal of informal communication that has been going on for the last few years, attempts have been made to bring the subject of reunion to a practical issue. The President's proposition that the Institute and the Institution should be amalgamated was heartily carried without dissent. But the second resolution did not meet with such a pleasant reception. This was to the effect that the amalgamation should be effected by the voluntary liquidation of the Institute and of the Institution, and the transfer of all property and assets of the two bodies to a new Society, which might be called the Society of Gas Engineers, and have a memorandum and articles of association according to a form which had been circulated in advance among the members. But there was one clause in this memorandum which practically upset the whole business by giving away the trader question, respecting which the Institute has already spoken in no uncertain tone. It has been known, from the time of the split, that reunion could be had on these or similar terms. The clause in question provided that parties actually engaged as principal, managing director, agent or traveller of any concern doing business with gas undertakings should not be eligible for membership. This clause, if accepted, would have the effect of turning out a larger number of members than the Institution would bring in, and more than that, amongst those affected would be past presidents, such as Mr. Hepworth and Mr. John West, men who, on account of position and ability, are able to do more towards the proceedings than any average half dozen orthodox gas managers. Naturally this very drastic measure was received with a great show of opposition, especially as no adequate evidence was produced in its favor. It was considered advisable in the interests of all concerned and was a *sine quo non* on the the part of the Institution. It was also stated that all but three of the gentlemen concerned had signified their willingness to resign, but the two sample letters read did not help matters, as they indicated plainly that the willingness was merely a giving way to the wish of the President and Council. It was not a spontaneous action on their part and although as a matter of form and to facilitate negotiations they handed in their resignations, they would feel grieved if another door could not be found for them. In fact the reading of the letters was a direct help to the old Association element, who were ably represented by Mr. C. E. Jones and Mr. W. Carr, as mover and seconder of an amendment to the effect that the Institute should not be dissolved. The utterances of these gentlemen were characterized by a force and directness that was a marked contrast to the vague and faint hearted, half-apologetic tone of the supporters of the dissolution measure. The somewhat imaginative but none the less powerful deliverances made by Mr. Jones, to the effect that he declined to commit suicide and then to assist in his own funeral obsequies, followed by the eminently business-like statement by Mr. Carr, that while amalgamation was a desirable thing the price asked for it was too big, represented the wide spread determination to uphold the old Association which is to most of the members the same thing as the Institute. It is said that rats leave a sinking ship, but there is nothing to show that the Institute is sinking, and even if it was the average Englishman does not share that feature of the rat's character. If really convinced that the liquidation was a necessity in the interests of the profession, no doubt Messrs. Jones and Carr, with a large proportion of their following, would withdraw their opposition. But the absence of sufficiently confirmatory evidence to that effect, only served as an incentive to rally round the old flag. The resolution to wind up the Institute was decidedly floored. But at the same time negotiations were not closed. A resolution approving the principle of amalgamation and referring the matter back to the Council for further consideration, received hearty support.

Whatever course may be decided upon it appears that the idea of an inclusive Gas Institute has been dropped, and that the amalgamated body will be conducted on the old Association lines. It will be a Gas Engineers' Society, or Institute, devoted exclusively to the technical side of the gas industry. Whether the financial element have acted wisely or in a far sighted manner in withholding their support, is for the future to show. The panic of 1876-7 was succeeded by a swing in the other direction, and there has since been a tendency to regard gas dividends as perfectly secure whatever happens. With the advancements of science, the development of the oil trade, and the continual pushing and canvassing on behalf of electricity, neither gas nor anything else can afford to take up an indepenpent position, and expect that the selling department, the advertising, and the introduction of new appliances, can be left to take care of themselves. Nor is there any reason why work of this sort should be left to the unaided efforts of engineers and managers.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A CORRESPONDENT in Bridgeton, N. J., writing under date of the 19th inst., says: "At the annual meeting of the shareholders in the Bridgeton Gas Light Company the following gentlemen were elected Directors for the ensuing year: Daniel Bacon, H. W. Elmer, George H. Whipple, Samuel P. Fithian and John Smalley. At the organization meeting of the new Board, Daniel Bacon was elected President; H.W. Elmer, Secretary and Auditor; and B. F. Harding, Superintendent and Treasurer. We are about to commence some extensions to our plant, made necessary by the greatly increased business. The engineering end of the construction is with Mr. F. H. Shelton, of Philadelphia. The plans call for the placing of two new benches of 6's, and enlarged exhauster, condenser, scrubber and meter apparatus. The purifiers are to be enlarged from 6 feet by 8 feet to 8 feet by 12 feet. The connections throughout are to be 10 inch. With this rearrangement of our plant we think we will be able to take care of our increasing business for some time to come.—H."

MR. HENRY C. REW, of Chicago, well known throughout the gas industry, has donated to the village of Newark, N.Y., in which place his early youth was passed, a sum sufficient for the construction and furnishing of a free public library. Under the plan Mr. Rew will build the structure and equip it thoroughly as a model library, and maintain the same for one year, after which the local authorities have agreed to keep it going. The library is erected as a memorial to the parents of Mr. Rew, and the expenditure incurred will not be less than $12,000.

AT the annual meeting of the Nashville (Tenn.) Gas Company the following Directors were elected: T. H. Malone, A. H. Robinson, W. R. Cole, T. J. O'Keefe, J. H. Fall, Joseph H. Thompson, B. F. Wilson, J. B. Richardson and D. S. Williams.

THE authorities of Richmond, Va., have awarded to the Armitage Manufacturing Company the contract for the tar produced on the Municipal Gas Works for the next two years. The rate is $1.25 per barrel, which would seem a pretty good thing for the Company.

A CORRESPONDENT in Manchester, N.H., writing under date of the 20th inst., says: "The rumor mongers were right when they predicted, about a fortnight ago, that important changes were about to be made in the management of the Nashua Light, Heat and Power Company. At the annual meeting of the Company the following Directors were chosen: F. W. Estabrook, J. H. Tolles, G. E. Anderson, F. E. Anderson and Elbert Wheeler; President F. W. Estabrook; Treasurer and General Manager, Elbert Wheeler—who succeeds in these positions Frank E. Anderson; Clerk, J. H. Tolles. Mr. Walter A. Lovering retires altogether from active connection with the Company. The naming of Mr. Wheeler to the virtual management of the Company has been favorably received in the business circles of Nashua."

"B. S. M." is informed that the management of the Paducah (Ky.) Gas Light Company is still in the hands of the receiver, Mr. Saunders A. Fowler.

THE gas division of the plants of the Manchester (Va.) Light, Heat and Power Company is virtually completed. In fact the management expects to be supplying gas in a fortnight.

THE Messrs. Danforth, of Peoria, Ills., have acquired control of the gas and electric lighting interests of Pekin, Ills.

THE Erie (Pa.) Gas Engine Company has closed its shops in that city.

At the annual meeting of the Municipal Gas Company, of Albany, N. Y., the Directors elected were: Anthony N. Brady, Robert C. Pruyn, John Bowe, William McEwan, John G. Myers, Horace G. Young and John A. Delehanty.

The Long Beach (Cal.) Gas Company has been incorporated by Messrs. Th. S. C. Lowe, Horace M. Dobbins and James Cambell, and Caroline W. Dobbins and Florence Dobbins Lowe. The capital is put at $100,000, "all of which amount is fully subscribed."

The Citizens Gas Light and Coke Company, of Findlay, O., has been incorporated by Messrs. John M. Barr, David T. Davis, Merle D. Hosler, William V. Coons and J. F. Axline. It is capitalized in $300,000.

The Baltimore *American*, of the 20th inst., had this to say respecting the Consolidated Gas Company of that city: "The Board of Directors of the Consolidated Gas Company met yesterday afternoon for reorganization, and re-elected the old officers, namely: President, General F. C. Latrobe; Vice-President, James A. Gary; Secretary, N. T. Meginniss; Treasurer, J. W. Clarke. In the appointment of Standing Committees the personnel is practically unchanged, except that Mr. Henry R. Wilson, of New York, becomes a member of the Finance Board, in place of Mr. E. C. Benedict, of New York. The other members of the Committee are: Messrs. W. W. Spence and W. F. Frick. The Executive Committee includes Messrs. James A. Gary, George A. Von Lingen and John E. Hurst. President Latrobe is a member, ex-officio, of all the Committees. Questions as to the appoint ment of a committee to examine into gas methods in other cities and kindred matters, with a view to increasing the Company's business were referred to the Executive Committee. Messrs. Frank Tilford and Henry R. Wilson, of New York, attended the meeting of the Board, which was held at the Merchants' Club building, and returned to the Metropolis late in the afternoon. These gentlemen made the fight on behalf of the Company for proxies of New York holders, and were naturally pleased at the success of their side. When asked as to the future policy of the Company in the matter of increasing its output, the New York Directors stated that they were not in a position to make any definite statements at present, but that they may be in a position to talk at the next meeting, a month hence. In the meantime, they stated, Mr. Tilford, who is identified with the gas interests in New York, would send two practical gas experts to this city, in order that they may make a thorough study of the conditions of the gas business here in order to ascertain what could be done and the wisest course to pursue in order to improve the Consolidated Gas Company's business. Inquiry was made of the gentlemen from New York as to the basis for the latest report as to a prospective deal for the purchase of the Company. Mr. Wilson replied that if there was a promising deal he would like to get into it, but that he had no knowledge of a deal at this time. Early in the day, after Messrs. Tilford and Wilson had left their colleagues of the Board, they went with Mr. T. Edward Hambleton to the banking house of Hambleton & Co., and remained there for about 20 minutes, which led brokers in the neighborhood to speculate as to whether or not the first steps for another deal were being taken."

The proprietors of the Niagara Falls (N. Y.) Gas and Electric Light Company are making notable extensions to the distributing division of their enterprise.

The Council of Steelton, Pa., refused to pass over the veto of Burgess Lewis the franchise granting the right to certain parties to manufacture and distribute gas in that borough. The authorities say now that any properly constituted company which will agree to sell gas at the rate of $1.60 per 1,000 on lighting account and $1.50 per 1,000 on fuel account, less 20 per cent. for prompt payment, will have no trouble in securing a franchise.

Under the compromise between the authorities of Council Bluffs, Iowa, and the Council Bluffs Gas and Electric Light Company, the selling rate in that city for gas has been fixed at $1.45 per 1,000 cubic feet.

At the annual meeting of the Peoples Gas Light Company, of Rut land, Vt., the officers elected were: Directors, J. W. Cranston, G. H. Verder, T. J. Lyon, F. A. Field, A. H. Keyes and H. R. Kingsley. President, G. H. Verder; Secretary and Treasurer, H. R. Kingsley.

The proprietors of the Huntsville (Ala.) Gas Light Company are finally at the work of improving that plant. The determination to better its condition took time; but better late than never.

At the annual meeting of the shareholders in the Chelsea (Mass.) Gas Light Company the officers chosen were: Directors, J. K. Montgomery, A. D. Bosson, George W. Moses, F. G. Low and Thos. Martin. President, J. K. Montgomery; Vice President and Counsel, A. D. Bosson; Treasurer and General Manager, George W. Moses.

Regarding the "Cost of Power in Bulk," the *Journal of Gas Lighting* notes that some useful information relative thereto has been published in *Engineering* by Mr. Philip Dawson, who has wisely depended on recorded facts and eschewed estimates. Generally speaking, his data support the views of Mr. Parshall on this subject. He offers as reliable the conclusion that there is every reason to anticipate that power can be produced in very large well designed stations, all charges included, such as interest on capital and sinking fund, for little over half a farthing per Board of Trade unit at the switchboard. The largest items in the cost of generating power are fuel and labor. On average American results, the fuel costs from 50 to 70 per cent. of the whole, wages coming next with from 13 to 26 per cent. The cost of the plant proper is, on the average, from one-half to three fourths of the total cost of the complete installation, including land, buildings and mains. Consequently, any little additional capital expenditure calculated to permanently reduce the cost of producing the power is well worth favorable consideration, especially when the plant runs practically continuously, as in the case of traction and power transmission. Continuous employment for the plant is the one essential condition for securing the greatest economy in production; but it does not yet appear what size of plant best realizes the ideals of the mechanical engineer. Mr. Dawson is emphatic, however, upon the point that a station which runs for lighting purposes only will not generate power cheaply, and *vice versa*. To design an economical station for traction or power transmission is special work requiring a great deal of knowledge and experience which practice in the lighting branch of electrical engineering cannot supply.

The public lighting of Wilmington, Del., in so far as that is being performed by means of incandescent and arc electric lamps, does not seem to be giving unqualified satisfaction, an opinion that resulted from a reading of the following letter recently forwarded to the Wilmington City Electric Company by the Board of Directors of the Street and Sewer Department of Wilmington: "Gentlemen—We beg to again call your attention to the fact that the globes in arc lamps throughout the city have not been cleaned. These dirty globes seriously impair the illumination from lamps, many of which do not appear to be furnishing illuminating power of even a nominal rating. Lamps in various locations have been reported to you as out and not burning night after night, it being manifest that such lamps are either of bad mechanical construction or not properly attended, and your oft-repeated excuse and explanation of the cause being from crooked carbons cannot be longer accepted as a good and sufficient reason for such trouble. Incandescent lamps receive no attention, your people not even attempting to make an inspection, and the only time such lamps are visited is when it is reported to you that the lamp is broken or the elements have broken your line. The candle power of such lamps being given as 24 is reduced on account of this inattention to an average of not more than 8 candle power. This practice from a commercial business standpoint would be almost criminal to private business interests if allowed to continue, particularly so when you remember that you inform consumers of current that the vitiated carbons in incandescent lamps consume a maximum amount of current without producing the minimum illumination, unless the minimum illumination be considered nil. We have now arrived at a period when we feel that unless this service is rendered first class and within the provisions of your contract immediately, we will replace every incandescent lamp with gas service, and if necessary extend this change to arc service in localities most complained of. Finally, we would call your attention to the fact that durthe past three months we have reported to your office lamps out and not burning amounting to 509, of which number 286 were arc lamps. These statements can be easily verified and with little trouble, and we feel that your immediate attention will be to our mutual advantage."

Mr. M. J. Ogden has resigned from the service of the Rockville (Conn.) Gas and Electric Company, in order to accept a responsible position with the Palmer (Mass.) Electric Light Company.

The inhabitants of Winfield, Iowa, will on August 6th vote upon a proposition to engage the town in the operation of a gas plant.

At the annual meeting of the Attleboro (Mass.) Gas Light Company the officers chosen were: Directors, G. A. Dean, Everett Capron,

Jas. E. Blake, H. M. Daggett, Jr., Clarence L. Watson and A. W. Sturdy; President, George A. Dean; Vice-President, Everett Capron; Treasurer, A. W. Sturdy; Supt., Everett Capron.

At the annual meeting of the Taunton (Mass.) Company's shareholders no change was made in the excutive management. The *Gazette*, in noticing the meeting, said that a subsequent meeting to be called action will probably be taken on increasing the capital stock and preparing for moving the plant to Weir village.

The Market for Gas Securities.

City gas shares held their values well during the week, with fairly good trading in Consolidated. The opening price to day (Friday) was 179½ to 180, and the closing was 179¾ to 180. The "Board of Trustees" of the Consolidated Company have notified the shareholders that stockholders of record, August 10th, will have the privilege of subscribing, at any time before August 20th, to the extent of 25 per cent. of their holdings, for additional stock at the price of $150 per share, payable in instalments of $50 each, on August 20 and September 5 and 25, respectively, at the National City Bank of New York, No. 52 Wall street. It is also determined that no subscriptions will be received on holdings of fractional shares. The new certificates will not be issued formally until October 2d, and it will not participate in dividends declared prior to that date. The next move will be the absorption of the Mutual.

Brooklyn Union constantly exhibits evidence of increasing strength, and our mark for it of 200 before Christmas is not at all out of the way.

Consolidated, of Baltimore, is steadier, Peoples, of Chicago, shows no change of moment, and Laclede are dull.

The general situation favors the investor, especially in the instance of gas bonds, and to our mind New Amsterdam 5's are a very good speculation at the quoted figures.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

July 30.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$4,595,200	100	179⅝	180
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	104	104¾
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River .. Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	121	125
Preferred	5,000,000	100	141	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	170	175
" " Bonds (5's)	15 000,000	1,000	116	119
Bay State	50,000,000	50	1	1½
" Income Bonds	3,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	85
" 1st Mtg. 5's	475,000	1,000	96½	97½
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5¼
" " Bonds, 5's	5,250,000	1,000	64	67
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,907,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,036,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	200¾	201
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	55	55¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99¼	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	95	100
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co	250,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	86
Bonds, 1st 5's	3,822,000	1,000	101¾	103
Laclede, St. Louis	7,500,000	100	75	75¼
Preferred	2,500,000	100	96	100
Bonds	10,000,000	1,000	110	110½
Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	..
Madison Gas & Elec. Co.	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co Bonds, 6's	6,000,000	..	..	55
New Haven	4,600,000	..	..	101
Nashville Gas Lt. Co.	1,000,000	25	280	300
Oakland, Cal.	1,000,000	50	110	..
" Bonds	2,000,000	..	46	47
Peoples G. L. & Coke Co., of Chicago	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	25,000,000	100	98¾	99
2d " "	20,100,000	1,000	111⅝	111½x
Rochester Gas & Elec. Co.	2,500,000	1,000	104	105
Preferred	2,150,000	50	88	..
Consolidated 5's	2,150,000	50	118	..
San Francisco, Cal.	2,000,000	..	87½	90
St. Paul Gas Light Co	10,000,000	100	47¼	47½
1st Mortgage 6's	1,500,000	100	57½	58½
Extension, 6's	650,000	1,000	82	85
General Mortgage, 5's	600,000	1,000	..	..
St. Joseph Gas Co	2,428,000	1,000	88	90½
" 1st Mtg. 5's	1,000,000	100	42	44
Syracuse, N. Y.	750,000	1,000	96½	98
Bonds	1,750,000	100	14	15
Washington, D. C	1,812 000	1,000	88½	93
First mortgage 6's	2,000,000	20	270	271
Western, Milwaukee	600,000	..	..	..
Bonds, 5's	4,000,000	100	95	98
Wilmington, Del.	3,880,000	..	104	106
	600,000	50	200	210

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	198
Fred. Bredel, Milwaukee, Wis.	182
Geo. R. Rowland, New York City	193
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	193
American Gas Co., Phila., Pa.	182
David Leavitt Hough, New York City	192
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	179
Baxter & Young, Detroit, Mich.	194
United Gas Improvement Co., Phila., Pa.	187
James T. Lynn, Detroit, Mich.	198
A. E. Boardman, Brevard, N. C.	192

GAS WORKS APPARATUS AND CONSTRUCTION.

	Page
James R. Floyd's Sons, New York City	196
Continental Iron Works, Brooklyn, N. Y.	194
Deily & Fowler, Phila., Pa.	198
Kerr Murray Mfg. Co., Fort Wayne, Ind	192
Stacey Mfg. Co., Cincinnati, Ohio.	195
Bartlett, Hayward & Co., Baltimore, Md.	193
Davis and Farnum Mfg. Co., Waltham, Mass.	192
R. D. Wood & Co., Phila., Pa.	194
Isbell-Porter Company, New York City	194
Fred. Bredel, Milwaukee, Wis.	182
United Gas Improvement Co., Phila., Pa.	187
National Gas and Water Co., Chicago, Ills	189
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	179
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	193
American Gas Co., Phila., Pa.	182
Logan Iron Works, Brooklyn, N. Y.	196
Riter-Conley Mfg. Co., Pittsburgh, Pa.	195
Baxter & Young, Detroit, Mich.	192
American Bridge Co., New York City	181
G. Shepard Page's Sons, New York City	192
James T. Lynn, Detroit, Mich.	192
A. E. Boardman, Brevard, N. C.	198
Sutherland Construction & Improvement Co., N. Y. City	180
Chris. Cunningham & Son, Brooklyn, N.Y.	178

PROCESSES.

	Page
Bartlett, Hayward & Co., Baltimore, Md.	193
United Gas Improvement Co., Phila., Pa.	187
Burdett Loomis, Hartford, Conn.	194
National Gas and Water Co., Chicago, Ills.	189
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	179
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	193
Sutherland Construction & Improvement Co., N.Y. City	180
R. E. Cholliar, St. Louis, Mo.	180

SCRUBBERS AND CONDENSERS.

	Page
R. D. Wood & Co., Phila., Pa.	194
James R. Floyd's Sons, New York City	196
Continental Iron Works, Brooklyn, N. Y.	194
Logan Iron Works, Brooklyn, N. Y.	196
Riter-Conley Mfg. Co., Pittsburgh, Pa.	195

TAR AND CARBONIC ACID EXTRACTOR.

	Page
R. D. Wood & Co., Phila., Pa.	194

AMMONIA CONCENTRATORS.

	Page
Michigan Ammonia Works, Detroit, Mich.	176
American Gas Company, Phila., Pa.	182

GAS METERS.

	Page
John J. Griffin & Co., Phila., Pa.	180
American Meter Co., New York and Philadelphia	199
Helme & McIlhenny, Phila., Pa.	199
D. McDonald & Co., Albany, N.Y.	197
Nathaniel Tufts Meter Co., Boston, Mass.	198
Maryland Meter and Mfg. Co., Baltimore, Md.	196
Metric Metal Co., Erie, Pa.	199
Keystone Meter Co., Royersford, Pa.	198
Detroit Meter Company, Detroit, Mich.	199

PREPAYMENT METERS.

	Page
American Meter Co.. New York and Philadelphia	199
John J. Griffin & Co., Phila., Pa.	180
D. McDonald & Co., Albany, N. Y.	197
Helme & McIlhenny, Phila., Pa.	199
Nathaniel Tufts Meter Co., Boston, Mass.	198

GAS AND WATER PIPES.

	Page
M. J. Drummond & Co., New York City	184
R. D. Wood & Co., Phila., Pa.	194
Warren Foundry and Machine Co., New York City	184
Donaldson Iron Co., Emaus, Pa.	184
Chris. Cunningham & Son, Brooklyn, N.Y.	178
Cornell & Underhill, New York City	184
Charles Millar & Son Co., Utica, N. Y.	184

GAS MAIN STOPPERS.

	Page
Safety Gas Main Stopper Co., N. Y. City	179

GAS TAPPING MACHINES.

George Light, Dayton, O..... 177
H. Mueller Manufacturing Company, Decatur, Ills..... 177

FLEXIBLE JOINTS.

Campbell Mfg. Co., Stamford, Conn..... 176

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y..... 189

GAS COALS.

Penn Gas Coal..... 191
Perkins & Co., New York City..... 190
Despard Gas Coal Co., Baltimore, Md..... 191
Westmoreland Coal Co., Phila., Pa..... 191
Berwind-White Coal Mining Co., New York and Phila... 190

CANNEL COALS.

Perkins & Co., New York City..... 190
Greasy Creek Cannel Coal and Tramway Co., Chicago.. 176

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills..... 179

GAS ENRICHERS.

Standard Oil Co., New York City..... 191
The Sun Oil Co., Pittsburgh, Pa..... 191

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 191

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 178

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 189
Isbell-Porter Co., New York City..... 194
R. D. Wood & Co., Phila., Pa..... 194
Wm M. Crane Co., New York City..... 179

CEMENTS.

C. L. Gerould, Galesburg, Ills..... 188

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J..... 188
Adam Weber, New York City..... 188
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 188
Cyrus Borgner, Phila., Pa..... 188
James Gardner, Jr., Co., Pittsburgh, Pa..... 188
Henry Maurer & Son, New York City..... 188
Baltimore Retort and Firebrick Co., Baltimore, Md..... 188
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 188
Brooklyn Firebrick Works, Brooklyn, N. Y..... 188
Missouri Firebrick Co., St. Louis, Mo..... 188

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md..... 193
Fred. Bredel, Milwaukee, Wis..... 188
J. H. Gautier & Co., Jersey City, N. J..... 188
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 188
Adam Weber, New York City..... 188
Missouri Firebrick Co., St. Louis, Mo..... 188

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City..... 194
Continental Iron Works, Brooklyn, N.Y..... 194
Logan Iron Works, Brooklyn, N. Y..... 196
R. D. Wood & Co., Phila., Pa..... 194

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa..... 186

BURNERS.

C. A. Gefrorer, Phila., Pa..... 194
Wm. M. Crane Co., New York City..... 19
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 179

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 179

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila..... 186
Thos T. W. Miner, New York City..... 177

PURIFIERS.

Stacey Mfg. Co., Cincinnati, O..... 180

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 189

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y..... 178
Chapman Valve Manufacturing Co., Boston, Mass..... 178
R. D. Wood & Co., Phila., Pa..... 194
Continental Iron Works, Brooklyn, N. Y..... 194
The P. H. & F. M. Roots Co., Connersville, Ind..... 183
Isbell-Porter Co., New York City..... 194
The Western Gas Construction Co., Fort Wayne Ind.... 200

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 183
Isbell-Porter Company, New York City..... 194
Connelly Iron Sponge and Governor Co., New York City 189

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 195

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City..... 177

PURIFIER SCREENS.

John Cabot, New York City..... 178

GAS STOVES.

American Meter Co., New York and Philadelphia..... 185
Maryland Meter and Manufacturing Co., Baltimore, Md. 193
Keystone Meter Co., Royersford, Pa..... 198
Nathaniel Tufts Meter Co., Boston Mass..... 198
Wm. M. Crane Co., New York City..... 177

HOT WATER HEATERS.

Wm. M. Crane Co., New York City..... 186

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y..... 193

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 193
Continental Iron Works, Brooklyn, N. Y..... 194
Deily & Fowler, Philadelphia, Pa..... 196
Davis & Farnum Mfg. Co., Waltham, Mass..... 192
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 192
Stacey Mfg. Co., Cincinnati, Ohio..... 195
R. D. Wood & Co., Philadelphia, Pa..... 194
Logan Iron Works, Brooklyn, N. Y..... 196
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 195

STORAGE TANKS.

Chris. Cunningham & Son, Brooklyn, N.Y..... 178

GAS SECURITIES.

Henry Marquand & Co., New York City..... 176

ADVERTISING.

J. Howland Harding, New York City..... 176

BOOKS, ETC.

Newbigging's Handbook..... 197
Field's Analysis, 1899..... 181
Scientific Books..... 190
Digest of Gas Cases..... 191
Practical Photometry..... 184
Gas Flow Computers..... 198
Hughes' "Gas Works"..... 189
Gas Engineer's Pocket-Book..... 184
Excerpts from Reports of Gas Commissioners..... 159
Binders..... 184
Directory of Gas Companies..... 195
Practical Handbook on Gas Engines..... 197
Coal Tar Tree..... 180
Poole on Fuels..... 184

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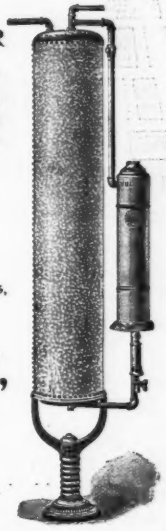

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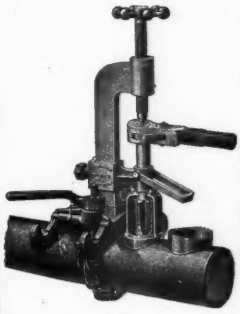

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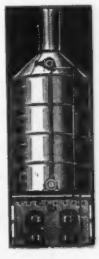

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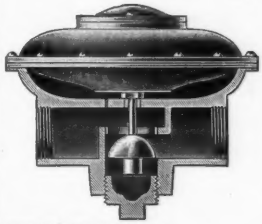

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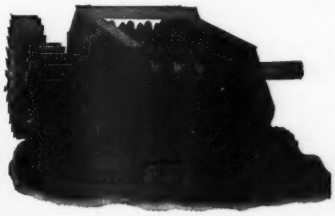

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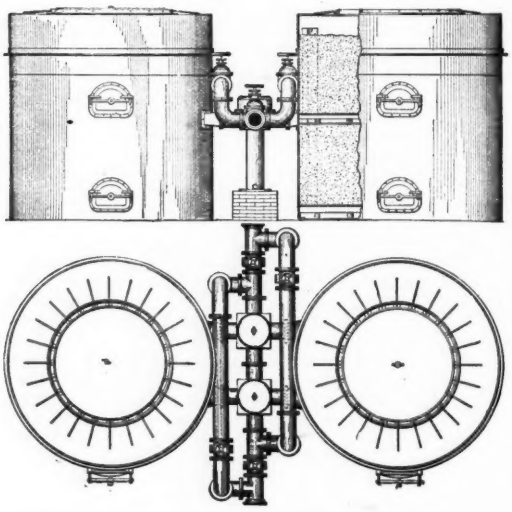

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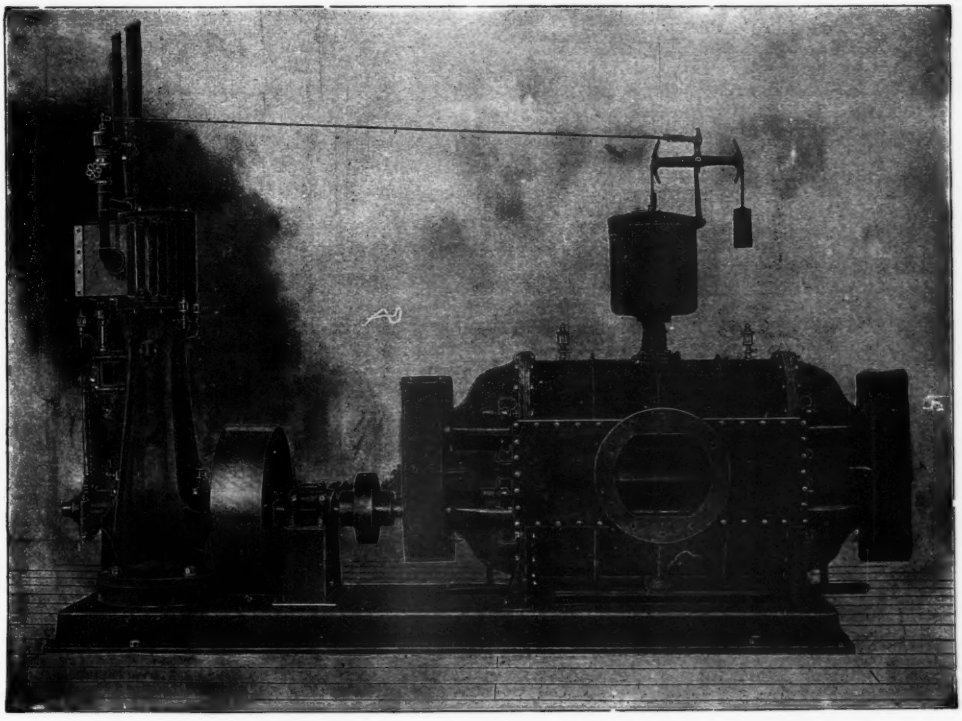

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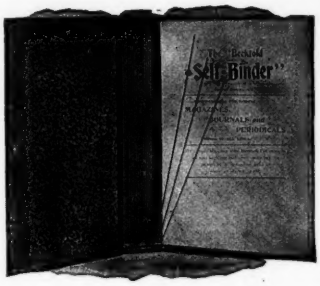

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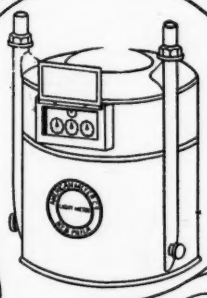
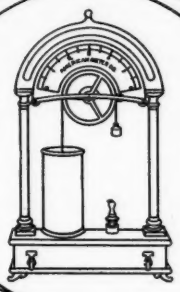
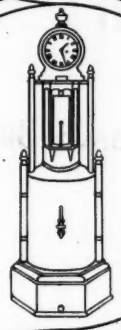
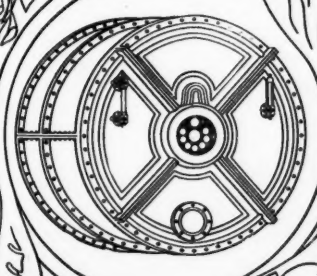




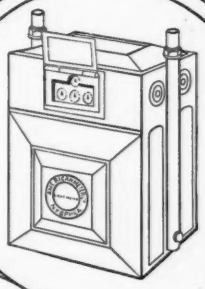


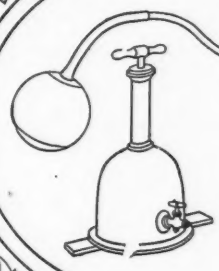


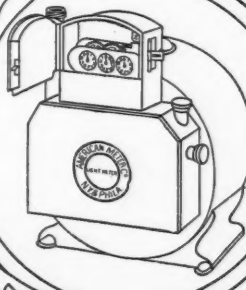
PUBLIC LIGHTING TABLE.

AUGUST, 1900.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	8.50 PM	4.00 AM	7.10	3.30
Thu.	2	9.20	4.00	7.10	3.30
Fri.	3	10.00 FQ	4.00	7.10	3.30
Sat.	4	10.40	4.00	7.10	3.30
Sun.	5	11.30	4.10	7.10	3.30
Mon.	6	12.20 AM	4.10	7.10	3.45
Tue.	7	1.30	4.10	7.10	3.45
Wed.	8	2.30	4.10	7.10	3.45
Thu.	9	No L.	No L.	7.10	3.45
Fri.	10	No L. FM	No L.	7.10	3.45
Sat.	11	No L.	No L.	7.10	3.45
Sun.	12	7.30 PM	8.50 PM	7.10	3.45
Mon.	13	7.30	9.20	6.55	4.00
Tue.	14	7.30	10.00	6.55	4.00
Wed.	15	7.30	10.30	6.55	4.00
Thu.	16	7.30 LQ	11.20	6.55	4 00
Fri.	17	7.30	12.00	6.55	4.00
Sat.	18	7.30	12.50 AM	6.55	4.00
Sun.	19	7.20	1.50	6.55	4.00
Mon.	20	7.20	2.50	6 45	4.10
Tue.	21	7.20	4.20	6.45	4 10
Wed.	22	7.20	4.20	6.45	4.10
Thu.	23	7.20	4.20	6.45	4.10
Fri.	24	7.20 NM	4.20	6.45	4.10
Sat.	25	7.20	4.20	6.45	4.10
Sun.	26	7.10	4.20	6.45	4.10
Mon.	27	7.10	4.20	6.30	4.20
Tue.	28	7.10	4.20	6.30	4.20
Wed.	29	7.20	4.20	6.30	4.20
Thu.	30	8.00	4.20	6.30	4.20
Fri.	31	8.40	4.20	6.30	4.20







TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

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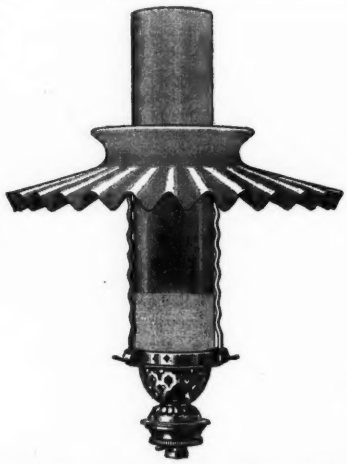

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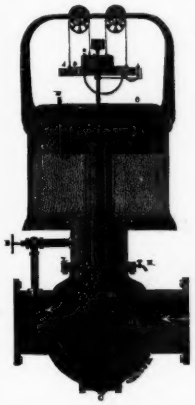

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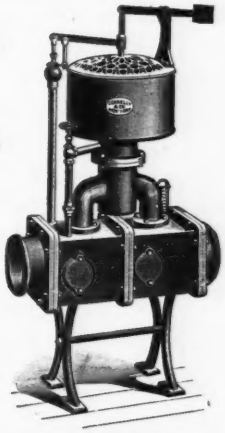

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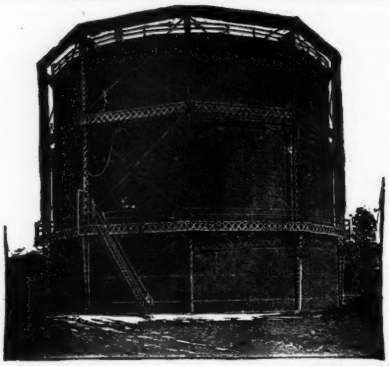

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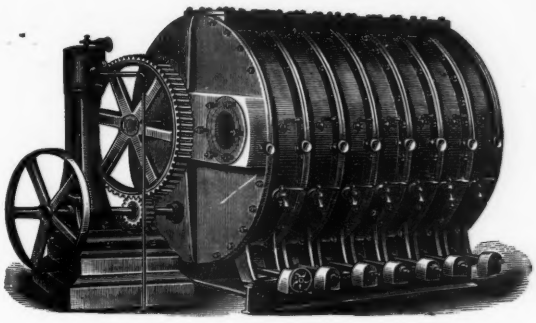

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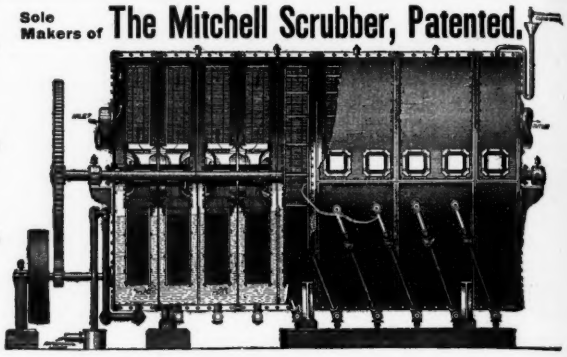

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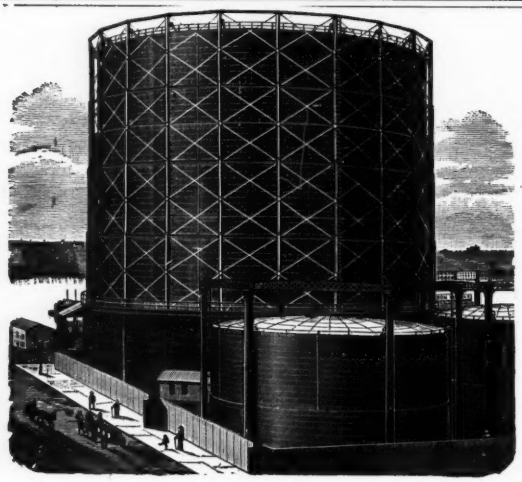

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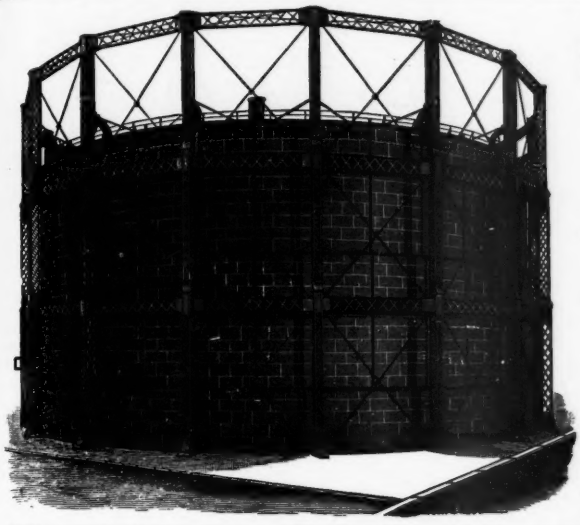

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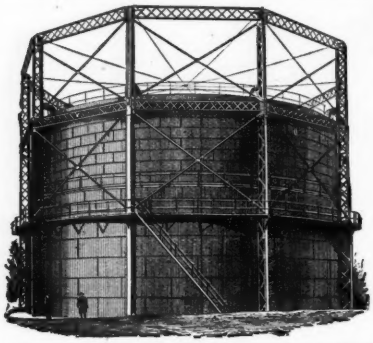

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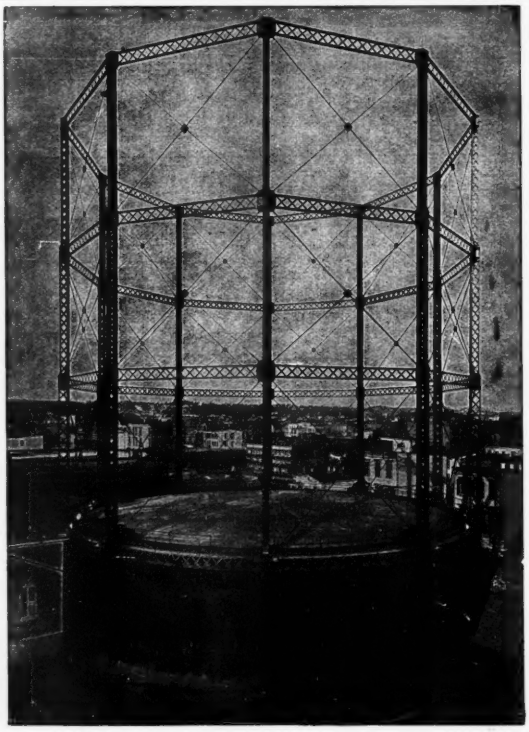

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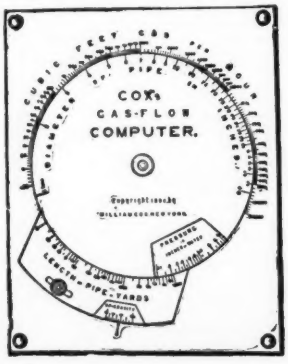

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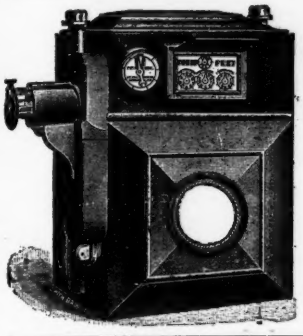

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